Inventory of Reptiles and Amphibians at Seven National Park Service Units in the Northern Great Plains from 2002-2003.

Final Report

By:

Brian E. Smith, Jodi L. Massie, and Ben G. Blake
Black Hills State University
1200 University Street Unit 9044
Spearfish, SD 57799

Submitted to:
Northern Great Plains Inventory & Monitoring Coordinator
National Park Service
Mount Rushmore National Memorial
Keystone, South Dakota 57751

December 31, 2004

Contents

Executive Summary

We inventoried the herpetofauna of Devil's Tower National Monument, Fort Laramie National Historic Site, Fort Union Trading Post National Historic Site, Jewel Cave National Monument, Knife River Indian Villages National Historic Site, Mount Rushmore National Monument, and Scott's Bluff National Monument during 2002 and 2003. Primarily, we used a combination of visual surveys and calling surveys of chorusing amphibians to inventory each park. We also surveyed prairie dog towns at night for tiger salamanders (*Ambystoma tigrinum*). We occasionally surveyed roads and trails at night, but this technique was not as successful as the other three techniques we used. Visual surveys were the best technique we used, although our success rate was low (0.33 specimen/person-hour in 2002 and 0.79 specimen/person-hour in 2003 for all parks combined). Calling surveys were useful to inventory some frogs, but only three species were routinely found on these surveys; the Woodhouse's toad (*Bufo woodhousii*), boreal chorus frog (*Pseudacris maculata*), and the northern leopard frog (*Rana pipiens*). Northern leopard frogs call sporadically and are difficult to hear and we think call surveys underestimate the abundance of this species.

Our main objective was to assess the presence or absence of herpetofauna expected on each park unit. Our success was poor; from 33.3% to 60% of the species were found, an average of 51.6% for all parks combined. The poor success rate was probably due to the difficulty of finding several species throughout the Great Plains and to lack of resources to completely survey any of the park units. Species that are particularly hard to find in the northern Great Plains are the western hog-nosed snake (*Heterodon nasicus*), pale milk snake (*Lampropeltis triangulum*), and the greater short-horned lizard (*Phrynosoma hernandesi*). In addition, the greater short-horned lizard is at the edge of its range on many of these parks. Species that only come out during or immediately following heavy rains, Great Plains toads (*Bufo cognatus*) and Plains spadefoots (*Spea bombifrons*), were also not observed because heavy rains were rare or lacking during the survey period. All the parks we worked on had also suffered several years of drought. Species richness averaged 13.0 species/park and we did not expect to find five of these species at many parks, so we expected low success rates (5/13, or 61.5%) on each park. Our success rate was lower because other species can be difficult to observe as well. These cases are discussed for each park.

To more adequately survey these parks we recommend more intensive study on each park. Drift fences should be installed and monitored for several weeks or months in an effort to find species that are rare or rarely observed. Investigators should be stationed on park units for weeks or months to find toads that are observed only during and slightly after heavy rainfall events. Though these tasks sound daunting, seasonal technicians can be trained to identify these species (most of them are easily identified) and conduct calling surveys for Great Plains toads and Plains spadefoots. Our crew can go to each park to assist in the construction of drift fences that can be monitored by trained seasonal technicians throughout the summer. Even with this effort, success at observing these rare species is not assured.

We saw few management issues on any of the parks, but we have pointed out specific needs for each park. The most obvious issue is that wetlands need to remain in a relatively natural state. Spring boxes should be removed from springs to allow small wetlands to build up around the springs. Stock dams or other water sources that have

been manipulated should be allowed to return to a more natural state. We do not think prescribed burning is a serious issue on any of these parks, and in general visitation probably does little harm on these parks, because visitor activity is almost completely confined to visitor's centers. At Devil's Tower and Scott's Bluff we have recommended specific steps to reduce potential interactions between visitors and prairie rattlesnakes. Snake densites are rare across the region and should be protected whenever they are found. We suggest monitoring northern leopard frogs and garter snakes (*Thamnophis* species) on some parks. If dens are found, densite monitoring should be instituted.

INTRODUCTION AND BASIC DESIGN OF THE STUDY

During 2002 and 2003, we surveyed seven park units throughout the northern Great Plains, including Devil's Tower National Monument, Fort Laramie National Historic Site, Fort Union Trading Post National Historic Site, Jewel Cave National Monument, Knife River Indian Villages National Historic Site, Mount Rushmore National Monument, and Scott's Bluff National Monument. Details specific to each park unit are discussed in each subsection of this report, but our methods were the same on each park. In this section, we discuss our basic methodology.

At most park units we used four inventory techniques: Call surveys for amphibians (Berrill et al., 1992; Peterson and Dorcas, 1994; Zimmerman, 1994; Bishop et al., 1997; Bonin et al., 1997; Lepage et al., 1997; Johnson, 1998; Mossman et al., 1998), visual encounter surveys (Crump and Scott, 1994), and road or trail cruising (Shaffer and Juterbock, 1994). We also used the "salamander survey", a method designed to survey specifically for *Ambystoma tigrinum* (tiger salamanders) in the northern Great Plains (Kolbe et al., 2002). Another method that can be used to inventory reptiles and amphibians involves the construction of drift fences (Corn, 1994), but typically drift fences require considerable time and resources to build, they require constant maintenance, and they must be checked daily. Because we visited park units for a few days at a time with long periods between visits, it was not possible or useful to install drift fences. However, drift fences are capable of discovering some species of herpetofauna that are difficult to find using any other survey technique.

Calling surveys: Call surveys are nighttime surveys designed to ascertain the presence of calling frogs during the breeding season (Berrill et al., 1992; Lepage et al., 1997). Investigators visited breeding ponds and listened for calling amphibians for 15 minutes, recording the species that were heard calling. We tried to visit ponds at least three times during the spring and early summer calling period (April to June, depending on weather conditions). The earliest species to call at each park were boreal chorus frogs, *Pseudacris maculata*, and we used this species as a "trigger" to initiate calling surveys. Calling surveys can be used to record presence or absence of various species at a potential breeding site. At all the parks that we inventoried, only the boreal chorus frog and *Bufo woodhousii* (Woodhouse's toad) can be definitely recorded using the technique. Occasionally the northern leopard frog (*Rana pipiens*) can be heard, but this species calls sporadically and its call is very subdued in northern Great Plains populations (Smith, personal observations). The northern leopard frog is more easily spotted later in the season during visual encounter surveys (described below), basking at the edge of ponds or moving along small streams during the summer and early fall (June – October, depending on weather).

Visual encounter surveys (VES): VES was the predominant type of survey that we used. During a VES, investigators search appropriate microhabitats (see next paragraph) turning cover items searching for herpetofauna (Crump and Scott, 1994). The technique is the most efficient method to quickly inventory any area for herpetofauna. Presence and absence data are easily obtained and abundance data can be obtained as well. However, because herpetofauna are so rarely found in the northern Great Plains (previous studies have recorded from 0.15 – 0.29 specimens/person-hour; Smith et al., 1998), we

did not feel that it was appropriate to draw conclusions about the abundance of species using this technique.

In the northern Great Plains, in VES conducted at random sites the success rate is very low (from 0.15 – 0.29 specimens/person-hour; Smith et al., 1998). However, when VES are conducted near (within ca. 100 – 200 m) water sources, success rates can jump to 1.58 specimens/person-hour in some cases (Smith et al., in preparation). For this reason we thought it inappropriate to survey at random locations on a park and asked park staff to direct us to water sources, such as riparian strips, ponds of any size, and springs. On a VES, cover objects are turned in appropriate microhabitats searching for herpetofauna, many of which are typically found under cover (Crump and Scott, 1994). Abundance on a VES is very difficult to quantify; cover objects may be more or less common at survey sites and the area covered varies from site to site. Usually abundance for VES is recorded as the number of specimens found during a certain time period. We recorded abundance as the number of specimens found during a one hour search by one person (i.e., # of specimens/person-hour). Most of our searches lasted for two person-hours; each survey lasted from 30 – 40 minutes, depending on the size of the field crew (i.e., four (30 minutes) or three (40 minutes) people). Overall our success rate was 0.33 specimen/person-hour in 2002 and 0.79 specimen/person-hour in 2003. Call surveys were useful to find boreal chorus frogs and Woodhouse's toads and occasionally northern leopard frogs, but VES were used to find all the other species we discuss in this report.

Road or trail cruising: Roads are frequented by certain species of herpetofauna during the warmer parts of the summer, especially snakes (except garter snakes) and some toads (Shaffer and Juterbock, 1994). Most of the park units we worked on in this study lacked roads of sufficient length. We walked some trails on park units at night searching for snakes, but this technique was generally not very successful. We recorded virtually no specimens using this survey type.

Salamander surveys: Another survey type conducted at each park unit with a prairie dog town was the "salamander survey", invented by Kolbe et al. (2002) to search for salamanders in the northern Great Plains. This type of survey is particularly useful in finding terrestrial tiger salamanders, *Ambystoma tigrinum*, which often move only on evenings following rains (Petranka, 1998). In a salamander survey, investigators fan out across a prairie dog town at night with flashlights. Tiger salamanders live in burrows with prairie dogs and come to the entrance of burrows at night (Kolbe et al., 2002). Kolbe et al. (2002) found that, in the typical prairie dog town, from one to three salamanders could be found per 100 burrows. With a two or three person team, we could survey ca. 100 burrows in about 15 minutes. Once we found a tiger salamander, we noted the presence of tiger salamanders at the park unit and eliminated further searches of prairie dog towns. We have found that this survey type is the most efficient way of searching for tiger salamanders in the northern Great Plains. On parks without prairie dogs, we did not conduct specific searches for salamanders. However, some areas at Knife River Indian Villages National Historic Site had an abundance of rodent burrows that we surveyed unsuccessfully for tiger salamanders. Typically the other survey techniques that we used do not work well to sample tiger salamanders.

We used new data for each park to reconsider the original presence/absence tables that we were given by the National Park Service. We considered the known range of each species as well as the habitat favored by each species. We removed species from the list

of species expected at parks because appropriate habitat did not exist or because the species was extralimital at the park. In some cases we added species to the park's expected herpetofauna where the species was extralimital but where specimens have been found nearby and suitable habitat exists on the park. These species are indicated by a new category, "P" (for "possibly occurring on the park"), to identify species that might occur on the park. In some cases we used this category where the park was well within the range of a species but where we were uncertain whether suitable habitat existed on a park.

The most pertinent data we gathered are found in the tables of observed species and expected species for each park. These data are summarized separately for each park. We calculated the percentage of expected species found on each park by dividing the number of species observed at each park by the number of species we expected to find at each park after we reassessed the list of expected species for each park. Our lists of expected species were not the same as the original lists we were given by the park service, but we felt it was more accurate to provide a measure of the success of this study using a posteriori reassessments of the park's herpetofauna based on our experience at each park.

On all parks our inventory was seriously compromised by long-term drought (figures 1-7, pp. 37 – 40). We advise caution in interpreting some of our results, although we feel that we found most of the common species found on each park. We believe that abundance data, which is difficult to obtain in studies of this nature, is even less reliable in this study than in most species inventories.

Purpose of the Study

The purpose of this study was to inventory park units to confirm the presence of species we expected to find on each park unit. To save limited resources we did not continue to search for species we expected and found, although we found several specimens of certain species. An example is the salamander survey; we conducted these surveys on prairie dog towns in a park unit and discontinued the surveys when we found a single salamander. We lack the data to draw conclusions about the abundance of any species.

All the park units we studied are small (table 1, p. 41). Although it may be reasonable to expect certain species at each park because the park is within the species' range, it is unrealistic to expect to find a reasonably diverse cross-section of species at one small location within a region. In any small part of a larger landscape, like a small national park, herpetofauna may not be found for at least three reasons.

1) The park is too small to have a representative cross-section of habitats found in the region as a whole. Some herpetofauna are specialized and exist only in certain habitats (garter snakes are found along streams, for example) and if these habitats are not found within a small park unit then those species are not likely to be found on the park.

2) Species have not colonized the park. For example, the only garter snake at McNenny State Fish Hatchery in far western South Dakota is the red-sided garter snake, *Thamnophis sirtalis*. The Plains garter snake, *T. radix*, is the only garter snake found in and around Spearfish, South Dakota, about 16 km (10 miles) east of the fish hatchery. McNenny State Fish Hatchery is about the size of many of the park units we investigated.

3) Species do not occur within a park unit due to chance events.

DEVIL'S TOWER NATIONAL MONUMENT

Abstract

We found 0.18 specimen/person-hour on VES conducted in 2002 and 0.19 specimen/person-hour on VES conducted in 2003 at Devil's Tower National Monument. Nine species were found on the park. We believe that species richness on the park is probably 16 species, although as many as 17 species may be found at the park. We found 56.2% of the species we expected to find at Devil's Tower, similar to many other parks we surveyed. The park does not have many wetlands suitable for reptiles and amphibians. The riparian strip along the Belle Fourche River and spring sites might be important habitats for herpetofauna. However, spring boxes need to be removed from spring sites to foster the growth of wetlands around the springs. We saw little impact from visitors at the site, but recommend that visitors continue to be strongly discouraged from climbing the south-facing boulder pile near the visitor's center. It would be worthwhile to search for a rattlesnake den on the park.

Introduction and Methods

The four habitat types that we surveyed at Devil's Tower were ponderosa pine, grassland, a prairie dog town, and a riparian strip. On the northeastern side of the tower itself a small valley forested with deciduous trees was also surveyed.

Ponderosa pine habitat on Devil's Tower was typical of many areas in the Bear Lodge Mountains and Black Hills. It consisted primarily of ponderosa pine (*Pinus ponderosa*) forest with little ground cover. Quaking aspen (*Populus tremuloides*) is usually interspersed throughout ponderosa pine forest in the Black Hills area. In the Black Hills region ponderosa pine is typically devoid of many species of herpetofauna (Smith et al., 1998; in preparation).

The grassland habitat of Devil's Tower is within the Big Sagebrush – Wheatgrass Prairie vegetation type of Johnson and Larson (1999), although big sagebrush is not common at Devil's Tower. Common grasses of this vegetation type are western wheatgrass (*Pascopyrum smithii*) and junegrass (*Koeleria macrantha*), with big sagebrush (*Artemisia tridentata*) a common shrub. In the Black Hills area this type of habitat typically has few herpetofauna although certain species, especially the yellow-bellied racer (*Coluber constrictor*), are characteristic of these grasslands and reasonably common there (Smith et al., in preparation).

The prairie dog habitat at Devil's Tower consists of a prairie dog (*Cynomys ludovicianus*) town. Various species of vertebrates use prairie dog towns and may live commensally with the prairie dogs (Sharps and Uresk, 1990; Kolbe et al., 2002; Tyler and Shackford, 2002). Herpetofauna can commonly be found in prairie dog towns as well (Kretzer and Cully, 2001). Rattlesnakes (*Crotalus* species) are found in prairie dog towns (Klauber, 1972) and a prairie dog town at Wind Cave National Park housed a large population of tiger salamanders (Kolbe et al., 2002). Other than the prairie dog town, the habitat is very similar to the grassland at Devil's Tower. However, the grasses are affected by grazing by the prairie dogs.

The riparian strip at Devil's Tower National Monument consisted of the Belle Fourche River and associated deciduous forest. Tree species common in riparian or riverine areas in the northern Great Plains are the Plains cottonwood (*Populus deltoids*), the American elm (*Ulmus Americana*), and boxelder (*Acer negundo*) (Johnson and Larson, 1999). According to park staff green ash (*Fraxinus pennsylvanica*) was also found in the riverine strip of Devil's Tower. Various shrubs and dense grasses lined the river. In the northern Great Plains, these habitats are islands of lush vegetation within a relatively dry region. Biodiversity can be high along these strips in the northern Great Plains (Smith, personal observation), and species such as spiny softshell turtles (*Apalone spinifera*), Woodhouse's toads (*Bufo woodhousii*), and garter snakes (*Thamnophis* species) can commonly be found (Smith, personal observations).

Effort expended in each habitat type is tabled in table 2 (p. 41).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 3 (p. 42) lists the species that were expected to occur at Devil's Tower and the species we found there. Table 3 also shows our re-evaluation of species expected at the park. Overall, we found 0.18 specimen/person-hour on VES conducted in 2002 and 0.19 specimen/person-hour on VES conducted in 2003 on the park unit. In addition, Schmidt (unpublished data) found two species that we did not observe; the Plains spadefoot and pale milk snake. We consider these to be reliable records.

Nine species were found on the park (table 3). It is likely that 16 species are found at Devil's Tower; it is possible that 17 species could be found there (table 3). We found 37.5% of the species we expected to find at the park. With Schmidt's records included, we believe that there are reliable sightings of 56.2% of the herpetofauna present on the park. Overall, we felt that the park was not very diverse due to lack of water sources. The riparian area was probably the richest site, but specimens were also found at the springs on the park.

The most perplexing result was that we never found prairie rattlesnakes (*Crotalus viridis*) at Devil's Tower. We expected to find them in the rock at the base of the tower, where park staff and visitors had reported the species. Other species we did not find are rare and/or hard to find. The Plains spadefoot, *Spea bombifrons*, and the Great Plains toad, *Bufo cognatus*, are not found except after heavy rains in the spring or summer. Heavy rains are chance events in the northern Great Plains, and we were not on the park during heavy rains. Fortunately, Schmidt (unpublished data) trapped a Plains spadefoot in a mammal trap at the park, and we consider this to be a reliable record. The greater short-horned lizard, *Phrynosoma hernandesi*, western hog-nosed snake, *Heterodon nasicus*, and the pale milk snake, *Lampropeltis triangulum*, are all rare or rarely observed across the northern Great Plains (personal observations). For example, one of us (Smith) has not found a live specimen of any of these species in eight years of field work in the Black Hills region. However, Schmidt (unpublished data) found a pale milk snake in a mammal trap in the riparian zone, and we consider this to be a reliable record. In summary, we found all the species we expected to find; we did not find species that are rare.

Other species possibly present at Devil's Tower are the spiny softshell, *Apalone spinifera*, and the Plains garter snake, *Thamnophis radix*. The spiny softshell is known

from the Cheyenne River downstream of Angostura Reservoir in southwestern South Dakota (Smith, personal observations) and slightly south of Devil's Tower (Baxter and Stone, 1985). There is an unconfirmed sighting in the Belle Fourche River (Smith, interview with local rancher). This turtle is a species of larger river systems, and the Belle Fourche River is large enough that the spiny softshell might occur in the river at Devil's Tower. We have reclassified the spiny softshell as a species that possibly occurs at Devil's Tower National Monument. The other two turtles, *Chrysemys picta* (the painted turtle) and *Chelydra serpentina* (the common snapping turtle) should occur in the Belle Fourche River, but we lacked resources to trap for these species.

We have reconsidered all the garter snakes. The wandering garter snake, *T. elegans*, should not occur at the park since it is typically found at higher elevations in the Black Hills and Bear Lodge Mountains (Smith et al., in preparation). The Plains garter snake is at the edge of its range at Devil's Tower, but it has apparently been found there (Baxter and Stone, 1985). We did not find this usually common snake at Devil's Tower, however. The red-sided garter snake, *T. sirtalis*, is also at the edge of its range at Devil's Tower, and we found this species at the park. We have clarified the status of the wandering garter snake (not expected at the park), the Plains garter snake (expected at the park), and the red-sided garter snake (present at the park). We would like to see new records of the Plains garter snake at the park.

Recommendations to Park Management

Most habitats on Devil's Tower National Monument seem to be in relatively good shape for herpetofauna, although water is lacking. Reptiles and amphibians may be rare at the monument due to lack of water sources. The Belle Fourche River and its associated riparian zone and the two (unnamed) flowing springs are probably the most important habitats for herpetofauna at the monument. Other areas may be important for certain species, such as the prairie dog town for tiger salamanders and the rocky habitat at the base of the tower for snakes.

Given sightings of prairie rattlesnakes by park staff, we suspect there is probably a densite somewhere near or on the park but we were unable to find one. Densites are important areas to conserve to insure healthy snake populations (Smith et al., in preparation); they should be protected if found. Snakes must penetrate from 1 – 2 m into the ground to escape winter freezing in the northern Great Plains (Goode, personal communication) and sites with appropriate soil conditions are probably rare.

A natural fire regime can be maintained at Devil's Tower or any other park in the northern Great Plains. In a review of the literature deMaynadier and Hunter (1995) found that reptiles and amphibians benefited from prescribed fire. Fires also maintain open wetlands that are used by amphibians as breeding habitat (Russell et al., 1999). The effects of prescribed fire have not been studied in the northern Great Plains. We would recommend that fires be set later in the active season, such as late fall (October), to avoid killing herpetofauna outright. Spring and early summer are probably the worst times to burn at all parks.

We strongly recommend removal of spring boxes at Devil's Tower and at all parks in the northern Great Plains. Spring boxes prevent water from spilling out upon the surface of the ground. Water that puddles around springs can be utilized for breeding by amphibians and can thus attract herpetofauna that feed on amphibians, such as garter

snakes. Our experience has shown that springs with spring boxes or other alterations typically do not form these small wetlands. Occasionally, these wetlands can form into relatively large wet areas and become important sites for many species.

Typical monitoring suggestions for the northern Great Plains consist of call surveys of indicator amphibians, monitoring of garter snakes, and densite monitoring. We have discussed the design of these monitoring programs at the end of this report (see "Monitoring", pp. 30 – 31). We have few long-term monitoring suggestions for Devil's Tower due to the general absence of wetland sites. We suggest monitoring red-sided garter snakes along the Belle Fourche River, since these snakes are well known to eat amphibians and could help to gauge the health of the river in the park. It has been suggested that snakes that subsist primarily on amphibians are undergoing population declines because of ongoing amphibian declines (Gibbons et al., 2000); garter snake monitoring might help to indicate the health of any wetland or riparian corridor. Any snake densite that is found should also be monitored. Devil's Tower is one of the two parks we surveyed that we think has the potential to house a healthy population of prairie rattlesnakes and potentially other larger terrestrial snakes as well (the other park is Scott's Bluff National Monument).

Species of special concern to the park staff would be rare species such as the greater short-horned lizard (*Phrynosoma hernandesi*), western hog-nosed snake (*Heterodon nasicus*), and pale milk snake (*Lampropeltis triangulum*). Park staff should be trained to identify these three species. To establish whether any of these species are present on a park unit we primarily depend on reliable reports from park staff. Photographic evidence is helpful in these cases, but these species are usually easily identified. An amphibian that park staff need to be aware of and that has not been observed on the park is the Great Plains toad, which comes out after heavy rains. For some observers it is difficult to discern the difference between Great Plains and Woodhouse's toads. Park staff should be trained in the identification of both species.

We see two potential impacts to species on the park. Roads kill many herpetofauna (ca. 31,000 deaths over a four year period on one 3.6 km section of roadway; Ashley and Robinson, 1996), and road building should be minimized on any park, consistent with the park's mission to enhance visitation. Campgrounds should have similar impacts to herpetofauna as do roads, although there are no studies of how campground development affects herpetofauna. However, Devil's Tower, like most of the park units we inventoried, has few roads and one campground. The road may affect migration of snakes to and from densites and frogs to and from breeding localities; the majority of deaths recorded by Ashley and Robinson (1996) were northern leopard frogs. We are not aware of large numbers of snakes or frogs found dead on the road at Devil's Tower, however.

The second impact we envision involves park visitors. They pose a threat to snakes because they may kill them and venomous snakes pose a threat to visitors because venomous snakes can bite and injure visitors. Deaths from prairie rattlesnake bites are very rare, but bites can result in hospitalization and a stay in the intensive care unit. It is important to realize that there is no way to eliminate snakes from areas. Often snakes are moved by park staff to avoid contacts between rattlesnakes and visitors. In a study of timber rattlesnakes, Reinert and Rupert (1999) found that translocated snakes were five times as likely to die as non-translocated snakes and moved an average of four times as

far per day than non-translocated snakes. It is important to locate densites if new construction, campgrounds, or other enhancements are planned for the park. In at least one case (Wind Cave National Park) it is likely that the visitor's center was located near a snake den although the suspected den has never been found (Smith et al., 1998). Rattlesnakes frequently show up in the parking lot and other areas of heavy visitation at Wind Cave National Park (Smith, personal observations). Densites are also important to the conservation of snakes. If densites are found steps can be taken to enhance the visitation experience for the average park visitor and conserve snakes. Densites can be found by fielding trained herpetologists to search in likely areas for them and by using GIS modeling (Peterson, personal communication). The south-facing boulder field near the visitor's center seems like a good area for a densite but we did not find prairie rattlesnakes there. As a precaution, visitors need to be kept out of this area.

Vouchers Collected and Repository

No voucher specimens were collected at Devil's Tower National Monument.

FORT LARAMIE NATIONAL HISTORIC SITE

Abstract

We found 0.27 specimen/person-hour on VES conducted in 2002 and 0.97 specimen/person-hour on VES conducted in 2003 at Fort Laramie National Historic Site. In general we were impressed with the potential diversity of the wetlands of this flood plain type of habitat, but most of the wetlands did not fill with water during the drought years of 2002 and 2003. We found nine of 15 species that we expected would occur at Fort Laramie National Historic Site, or 60% of the expected species, slightly better success than we had at most parks. Species richness could be as high as 18 species at the park. We found few management issues at Fort Laramie. The irrigation canal above the park is affecting the wetlands along the river but we could not determine if it had a positive or negative impact. Grazing should be kept to a minimum, although we saw no signs of grazing damage. It is likely that northern leopard frogs and red-sided garter snakes could be monitored at the park. Visitors seemed to have little impact on the parts of the park that we think provide good habitat for herpetofauna.

Introduction and Methods

We surveyed three habitat types at Fort Laramie National Historic Site; riparian forest, grassland, and wetland/riverine. This categorization of habitat is somewhat artificial, however. The Laramie River runs through the middle main section of the park and the riparian area of the river was reminiscent of other riparian areas in the region. We concentrated our effort along the Laramie River and its floodplain. Cottonwoods lined the river along with dense shrub cover. The river is not wide at this point; usually not wider than ca. 10 m. Other parts of the historic site were reminiscent of typical floodplain habitat, with small ponds scattered throughout the site, except upland areas around the visitor's center and remaining structures of the fort. Some ponds were connected to the river and some were not connected to the river. Some were temporary, some appeared to be semi-permanent, and those connected to the river were permanent. The temporary and semi-permanent wetlands did not fill in 2002 or 2003. Johnson and Larson (1999) consider the grassland at Fort Laramie to be of the Central Shortgrass Prairie vegetation type. Common grasses in this type of grassland are blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), hairy grama (*Buchloe hirsuta*), and western wheatgrass (*Pascopyrum smithii*) (Johnson and Larson, 1999). Grassland was found in the upland area of the park. At this site, we concentrated our efforts along the river and at and around the wetland sites. Because the wetland sites away from the river did not fill during the study we feel that our inventory at Fort Laramie was compromised. However, we felt that the site would probably provide a relatively diverse mix of habitats in a wetter year.

Effort expended in each habitat type is given in table 4 (p. 42).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 5 (p. 43) lists the species that were expected at Fort Laramie and the species we found there. We found 0.27

specimen/person-hour on VES conducted in 2002 and 0.97 specimen/person-hour on VES conducted in 2003 at Fort Laramie National Historic Site.

Like most of the park units we visited, this site is not species-rich. We found nine species during our inventory. It is likely that 15 species occur there. It is possible that 18 species are found at Fort Laramie. We found 60% of the species we expected to find at the park. Due to the diverse mix of wetland types at the historic site, we felt that the area might be more diverse than many park units we visited, but we lack the data to address this question.

We would recommend further work at Fort Laramie to determine if the park's herpetofauna is very diverse. However, a study of diversity would require data on the abundance of herpetofauna, and these data are more difficult to obtain; the work could be resource-intensive.

As at most parks we studied, there were several species we expected to find at the park but did not find. Not surprisingly, virtually all of these are rare or are rarely observed. For example, we did not find the tiger salamander (rarely observed as adults and there were no prairie dog towns at Fort Laramie), Plains spadefoot (can only be observed during and immediately after heavy thunderstorms), the greater short-horned lizard (also rarely observed and possibly rare), the western hog-nosed snake (rarely observed and possibly rare), and the pale milk snake (rarely observed and possibly rare). There were few or no suitable ponds available for tiger salamander larvae when we visited the park. This was likely due to the long-term drought. Cope (1900) reported the greater short-horned lizard from Fort Laramie, but we would like to see more recent records of this species.

Interestingly, several species reach the limits of their range near Fort Laramie (Baxter and Stone, 1985). These are the Great Plains toad (found several km to the north; possibly at Fort Laramie but unlikely), the spiny softshell (found just downriver in the North Platte and possibly in the Laramie or North Platte Rivers at Fort Laramie), and the Plains garter snake (found just to the east of Fort Laramie). Of these, we would be somewhat surprised to find the Great Plains toad because it is relatively far out of its range. We would also not expect the Plains garter snake to be found at Fort Laramie since they frequently do not co-occur with the red-sided garter snake (Smith et al., in preparation). However, all three of these species could occur at Fort Laramie.

Also of note are the bullfrog (*Rana catesbeiana*) and northern sagebrush lizard (*Sceloporus graciosus*). We believe the bullfrog may well occur at or very near to Fort Laramie since it is found slightly downriver from Fort Laramie in the North Platte River (Baxter and Stone, 1985). We found bullfrogs at Scott's Bluff National Monument. We believe that the northern sagebrush lizard, while Fort Laramie is well within its range, probably does not occur at the park. The northern sagebrush lizard is usually common where it occurs, even in small isolated populations (Smith et al., in preparation). If populations existed on a small park like Fort Laramie, we should have found them. We doubt that lizards of any sort, except possibly the rarely observed greater short-horned lizard, occur on the park. In addition, park staff, including one 15-year employee, did not recall ever seeing a lizard on the park.

Recommendations to Park Management

We did not find any reason for major changes in park management at Fort Laramie National Historic Park. The importance of the site should be emphasized, however. For such a small park unit, we were generally impressed with the diversity of wetland areas. This is undoubtedly due to the Laramie River and associated small ponds. These ponds should be left in a natural state. Allowing water to puddle up around a pond provides microhabitats for a wider array of amphibians than a pond that has been manipulated in some way, such as with spring boxes, concrete tanks, dredging, or "cleaning". An irrigation ditch found above the park may affect these wetlands but we lack the data to address these possible effects.

Because of its potential as a relatively biodiverse area we would recommend another inventory during a wetter year or a more resource intensive survey that could address the abundance of reptiles and amphibians at the park. We could not fully assess the wetlands at Fort Laramie during the dry years of 2002 and 2003.

The most obvious park management issue at Fort Laramie is grazing, but the effects of grazing seem minimal at the park. A survey of the Black Hills in 2004 found that the most significant management issue was uncontrolled cattle grazing (Smith et al., in preparation). We did not notice significant grazing problems at Fort Laramie National Historical Park, but overgrazing has serious effects on herpetofauna (Reaser, 2000; Homyack and Giuliano, 2002; Jansen and Healey, 2003; Beever and Brussard, 2004). We would recommend that park managers consider this when grazing horses on Fort Laramie National Historic Park. However, horses do not appear to be on the park long enough to cause significant damage.

Species of interest at the park would be those of interest at most park units in the area; the greater short-horned lizard, the hog-nosed snake, and the pale milk snake. All these species are rare or are rarely observed. As we pointed out before, park staff can be easily trained to identify these species. Other species of interest at Fort Laramie are those that are at the edges of their range. We would especially be interested in sightings of the bullfrog or spiny softshell since we feel that they may well occur there. We would be more surprised if the Great Plains toad or Plains garter snake were found.

Because Fort Laramie has a number of small ponds, we feel that it might be worthwhile to establish a small amphibian monitoring program at the site (see "Monitoring", p. 30-31). In particular, the northern leopard frog could probably be monitored at Fort Laramie. Incorporating one or two wetlands at Fort Laramie into a larger, region-wide monitoring program could be helpful. We would also recommend garter snake monitoring at Fort Laramie as an indirect method of monitoring wetland health and amphibian abundance.

Except for the fort itself and the visitor center, we noticed no impacts of visitation at the wetland sites of Fort Laramie National Historic Site. Most of the wetlands area and the riparian habitat received little or no visitation as far as we could determine.

Vouchers Collected and Repository

No voucher specimens were collected at Fort Laramie National Historic Site.

FORT UNION TRADING POST NATIONAL HISTORIC SITE

Abstract

At Fort Union Trading Post National Historic Site we found 0.35 specimen/person-hour on VES conducted in 2002 and 0.65 specimen/person-hour on VES conducted in 2003. We found four of 12 species we expected at Fort Union, or 33.3% of the species we expected to find. Up to 13 species may occur on the park. The upland prairie at Fort Union is probably very poor habitat for herpetofauna. The riparian strip along the Missouri River provides a diverse mix of wetlands for a variety of herpetofauna. We recommend managing this area for herpetofauna by allowing a natural flooding regime if it is possible. Northern leopard frogs seemed relatively easy to hear at Fort Union and we recommend that the site be used as a frog monitoring site. The site can also be used to monitor garter snakes in the riparian area. We found little or no impact of visitors on the riparian area at Fort Union, which we felt was the most important habitat for herpetofauna on the park.

Introduction and Methods

Two habitat types are found at Fort Union Trading Post National Historic Site; a strip of riparian vegetation along the Missouri River and an upland prairie site. The upland prairie is not very diverse but the riparian strip along the river provides many microhabitats for reptiles and amphibians. We surveyed both habitat types.

We considered the upland prairie to be relatively poor herpetofaunal habitat. No wetland sites were found on the prairie and we expected little species richness or diversity. The yellow-bellied racer and bullsnake probably could be found there, but as we have mentioned before, herpetofauna are hard to find in the northern Great Plains in areas that are more than 100 – 200 m from a water source. Johnson and Larson (1999) consider Fort Union to be within the Northern Wheatgrass Prairie vegetation type. Common grasses within this vegetation type are western wheatgrass (*Pascopyrum smithii*), needle-and-thread wheatgrass (*Stipa comata*), and green needlegrass (*Stipa viridula*) (Johnson and Larson, 1999).

In contrast, the riparian strip on the north side of the Missouri River was a highly diverse mixture of microhabitats and vegetation, with ponds of all types, from permanent to temporary, and lush shrubs, grasses, and trees. The strip was narrow and not easily divisible into discrete habitat types, so we considered this complex mix as a single habitat for inventory purposes. The south side of the river consisted of a steep riverbank with little or no herpetofaunal habitat of note.

Effort expended in each habitat type is given in table 6 (p. 43).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 7 (p. 44) lists the species that were expected at Fort Union and the species we found there. We found 0.35 specimen/person-hour on VES conducted in 2002 and 0.65 specimen/person-hour on VES conducted in 2003.

We spent some time surveying the upland prairie but not surprisingly found almost no herpetofauna there. For a serious inventory of this habitat we would suggest installing a few drift fences, up to five fences but more than one fence. Due to lack of cover, observations of herpetofauna should be rare on the prairie. The habitat also seemed quite dry, so we would expect any movements to be made at night or on rainy, overcast days.

We expected to find 12 species at Fort Union but found only four species. It is possible that 13 species exist on the park. We found 33.3% of the species we expected to find at the park. Of the species we did not find, most of them are rare and/or difficult to observe; two are species of the upland prairie, but the upland habitat at Fort Union is particularly sterile and lacks wetlands. In the wetland/riparian area we found the commonly observed species we expected to find.

We felt that the riparian belt on the north bank of the Missouri River was the most important habitat type at Fort Union and the one most in need of management. Various species were common there, especially plains garter snakes, northern leopard frogs, and Woodhouse's toads. Fort Union was one of the few places where we found northern leopard frogs relatively easily and could hear calling choruses somewhat readily, although nighttime calling surveys were difficult to perform in the riparian belt due to heavy brush. Our surveys were typically conducted in clear habitat overlooking the riparian strip.

We did not find the following species: The tiger salamander (terrestrial adults difficult to find and larval ponds not found), the Great Plains toad (appropriate weather conditions lacking; possible lack of habitat, which is usually temporary depressions on upland prairie), the Plains spadefoot (for the same reasons as the Great Plains toad), the painted turtle (should have been easy to locate along the river), the snapping turtle (can be difficult to find in some areas), yellow-bellied racer (poor quality upland habitat), the western hog-nosed snake (appropriate habitat, such as loose soil, does not exist), the bullsnake (poor quality upland habitat), and the red-sided garter snake (possibly because the Plains garter snake was abundant on the park). Observations of any of these species would be important but we doubt that the western hog-nosed snake occurs at the park.

We have clarified the status of two rare species, the greater short-horned lizard and the western hog-nosed snake. Both species use loose soil that they tend to push through slightly below the surface of the soil (Platt, 1969; Sherbrooke, 2003). We did not find this type of microhabitat at Fort Union and would be surprised to observe either of these species there. In addition, the park is located just north and east of the known range of the greater short-horned lizard. Observations of the western hog-nosed snake would be notable but surprising.

We have also clarified the status of the northern sagebrush lizard. Appropriate habitat, such as rocky outcrops in sagebrush communities (Baxter and Stone, 1985), does not exist on the park.

Other species that may be of special interest include the Great Plains toad, the spiny softshell, the smooth green snake, and the red-sided garter snake. We doubt the Great Plains toad exists on the park because we did not find appropriate habitat, which typically are small depressions on upland prairie (Stebbins, 2003). However, temporary ditches might occur on the park suitable for reproduction. The spiny softshell occurs spottily in the region (Stebbins, 2003) and it might be found at Fort Union, but we have left its status unchanged. The smooth green snake is a species of wetter areas; in the Black Hills

it is found under rocks and debris around small streams and some lakes (Smith, personal observations). It is also spottily distributed around the northern Great Plains (Stebbins, 2003) but is not easily found in some areas (Smith, personal observations). The red-sided garter snake does not often co-occur with the Plains garter snake (Smith et al., in preparation) and may not occur on Fort Union, although it may be common elsewhere nearby the park.

Recommendations to Park Management

The most important habitat on Fort Union is probably the riparian strip on the north side of the river. This is the most species-rich habitat (eight, and perhaps nine, species should occur in the riparian strip) on the park unit. It probably has the most diverse herpetofaunal community as well, but we lack abundance data to draw definitive conclusions on diversity. The south side of the river appeared to be relatively poor habitat for herpetofauna.

Seasonal inundation of the riparian strip may be important but we lack data on the timing and extent of natural flooding. Nevertheless, we presume that some inundation of the area provides ponds of all types suitable for the reproduction of boreal chorus frogs, Woodhouse's toads, and northern leopard frogs. Species that eat these amphibians, such as red-sided garter snakes, would also benefit from a diversity of ponds. It is important to maintain diversity in pond type because boreal chorus frogs (small temporary to semi-permanent ponds), Woodhouse's toads (river oxbows and larger ponds along riparian strips), and northern leopard frogs (larger semi-permanent ponds) all need different types of breeding habitat.

We suggest that monitoring of northern leopard frogs be conducted at Fort Union. We discuss how to design a monitoring program in "Monitoring" on pp. 30 – 31. The reason why this might be particularly important at Fort Union is because northern leopard frogs are easier to hear at this park than at any other park unit that we visited during this study. A few (perhaps one to three) ponds can be picked that could be followed year after year. As part of a region-wide effort, the results might be illuminating. Garter snake monitoring (see "Monitoring" on pp. 30 – 31) would also be worthwhile at the park.

Species of special concern at the park would be those that we have identified for most of the parks in the region but some species probably do not exist at Fort Union. The western hog-nosed snake and greater short-horned lizard were mentioned previously. Another species of special concern is the northern leopard frog. We discuss its imperiled status in much of the United States in the "Conclusions and Monitoring" section (pp. 29 – 31) in this report and we think that it would be worthwhile to track the species at Fort Union, where the northern leopard frog seems abundant.

Vouchers Collected and Repository

No voucher specimens were collected at Fort Union Trading Post National Historic Site.

JEWEL CAVE NATIONAL MONUMENT

Abstract

At Jewel Cave National Monument we found 0.29 specimen/person-hour on VES conducted in 2002 and 1.17 specimen/person-hour on VES conducted in 2003. We found four of the seven species we expected to find, or 57.1% of the expected species. Species richness could be as high as 11 species. There seems to be little habitat on Jewel Cave National Monument for herpetofauna, but the northwest corner of the park may be more species rich since it is the wettest part of the park. We recommend that a stock tank at Chokecherry Spring be removed and the site monitored to see if a wetland suitable for herpetofauna develops at this site. Spring sites are often degraded by spring boxes, metal stock tanks, or stock dams, and removal of these structures might change springs to favor amphibian breeding, which would attract amphibian predators like snakes and possibly other herpetofauna. We saw few other management issues on the park and noticed little visitor impact away from the visitor's center.

Introduction and Methods

There were two habitat types that we investigated at Jewel Cave National Monument; these were burned and unburned ponderosa pine forest. We have previously discussed ponderosa pine forest and the paucity of herpetofauna in ponderosa pine forest, we discovered that the burn area at Jewel Cave was especially disturbed and we expected this forest to be very depauperate. Although burning can increase herpetofaunal diversity in some areas (deMaynadier, P. G., and M. L. Hunter, Jr. 1995; Russell et al., 1999), we did not expect it to do so in catastrophically burned ponderosa pine forest.

Effort expended in each habitat type is tabled in table 8 (p. 44).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 9 (p. 45) lists the species that were expected to occur at Jewel Cave and the species we found there. At Jewel Cave National Monument, we found 0.29 specimen/person-hour on VES conducted in 2002 and 1.17 specimen/person-hour on VES conducted in 2003. We also list species that we think should be found at the park given our results in table 9 (p. 45).

We expected Jewel Cave to be very depauperate due to the lack of water, presence of extensive ponderosa pine, and recent fire. Expected species richness was seven species. We found four species, or 57.1% of the species we expected to find on the park. Species richness could be as high as 11. Once again the species we found were common in the area or were common in suitable habitat. Paedomorphic tiger salamanders were found in the third filtered sewage pond at the park. Paedomorphic tiger salamanders tend to be found in permanent water and the sewage pond provided appropriate habitat. Tiger salamanders tolerate extremely polluted water in the Black Hills (personal observations) and it was not surprising to find this species in the sewage pond.

Jewel Cave offers little habitat suitable for herpetofauna. A few species might be of some interest to the park but we see little hope of finding most of them. The northern leopard frog could be present but we found no suitable wetlands for this frog. The

enigmatic pale milk snake might occur on the monument. Although rare, this species has been found in a number of habitat types throughout the Black Hills (Peterson, 1974; Smith et al., in preparation) and might be found at Jewel Cave. We found no suitable wetlands for the painted turtle, the snapping turtle, the smooth green snake, the redbelly snake, or the red-sided garter snake (the wandering garter snake, which was found at Jewel Cave, is less frequently found near water), and we have removed these species from the list of species expected from the park. Without the sewage treatment pond we probably would not have found tiger salamanders either, but terrestrial adults might cross the park on occasion. The park is probably too high in elevation for several species, including the Plains spadefoot, yellow-bellied racer, the bullsnake, and the greater short-horned lizard, and we have changed the status of these species from expected to possibly occurring on the park.

We have added the prairie rattlesnake to the list of species possibly occurring on the park. It is found to 1726 m elevation at places and in ponderosa pine forest (Smith et al., in preparation) in the Black Hills and may occur at Jewel Cave. Populations of prairie rattlesnakes can be found just south of Jewel Cave National Monument (Smith et al., in preparation).

Of special interest would be the rare pale milk snake, as at many parks in the northern Great Plains region, and the northern sagebrush lizard. The northern sagebrush lizard is common where it occurs in the Black Hills (Peterson, 1974; Smith et al., in preparation), but Black Hills populations are spotty and are at the edge of the species' range. A population is known from Water Draw Spring, ca. 4.5 km (3 miles) south of Jewel Cave National Monument.

Bogan and Ramotnik (1994) reported the Great Plains toad, smooth green snake, and prairie rattlesnake from Jewel Cave "or nearby". We have questions about their identification of the Great Plains toad because they are easily confused with the Woodhouse's toad. The smooth green snake came from the "bottom of Hell Canyon", which may or may not be on the park. Nevertheless, this record may indicate that smooth green snakes may have occurred on the park in 1994. Bogan and Ramotnik (1994) also report a prairie rattlesnake record, but the locality seems to be off the park. These specimens are housed at the University of New Mexico, Museum of Southwestern Biology, and could be examined to verify their identity and locality information.

Recommendations to Park Management

We found little habitat at Jewel Cave that was essential for herpetofauna, which we believe makes it important to conserve wet areas on the park. Specifically, Chokecherry Spring could be an important site. When we visited the park, this spring was altered by a cattle tank. We recommend removing this tank to allow a more natural wetland to develop. As we have pointed out earlier in this report, springs should be left in their natural state on all park units. It is not possible to predict how this will affect Chokecherry Spring, but it could help to develop a wetland suitable for amphibians and reptiles. If the stock tank is removed, Chokecherry Spring should be monitored to see if the removal has allowed the development of a more significant wetland area. The northwest corner of the park is another wet area on the park potentially suitable for reptiles and amphibians. The only other "wetland" was the sewage pond. We do not expect the sewage pond to support herpetofauna other than tiger salamanders.

We recommend that park staff report any lizards found on the park; they would probably be northern sagebrush lizards and could represent a unique, isolated population. The pale milk snake is rare and needs to be documented on the park if found by park personnel, as mentioned for many of the parks units we studied. However, we do not think any other herpetofauna of note occur on the park.

Vouchers Collected and Repository

No voucher specimens were collected at Jewel Cave National Monument.

KNIFE RIVER INDIAN VILLAGES NATIONAL HISTORIC SITE

Abstract

We found 0.16 specimen/person-hour on VES conducted in 2002 and 1.03 specimens/person-hour on VES conducted in 2003 on Knife River Indian Villages National Historic Site. Species richness on the park is probably 12 species; we found five species, or 41.7% of the species we expected. As many as 14 species might be found at the park. The riparian areas along the Knife and Missouri Rivers were generally not very diverse. This was probably due to the steep banks of the Missouri River in this area. The most serious management issue on the park could be the abundant stinging nettle in the Forest Loop area. We do not know how this affects the herpetofauna on the park. This management problem is being addressed by park staff using a variety of methods. We expect that prescribed burns will probably help to foster a healthier herpetofaunal population but we do not know how other manipulations of vegetation on the park, such as clearing of brush, will affect reptiles and amphibians. We recommend burning later in the season, such as in the fall, to avoid killing herpetofauna outright.

Introduction and Methods

Knife River Indian Villages National Historic Site is situated along the western bank of the Missouri River in central North Dakota. The predominant habitats at the site are a riparian strip and a forested upland with interspersed grasses. Part of the riparian strip is densely overgrown with trees and vegetation. Other parts are less overgrown, but the riparian strip, in general, is different than that at Fort Union National Historic Site. At Fort Union, the riparian strip consists of a relatively diverse mix of ponds and other wetland habitats. At Knife River, the banks of the Missouri River are steeper and few ponds exist in the riparian strip.

The forested upland at Knife River consists of a relatively thick boxelder (*Acer negundo*) forest with some grasses. Johnson and Larson (1999) refer to the grasslands in the Knife River area as a Northern Wheatgrass Prairie vegetation type. This vegetation type was described previously (Fort Union Trading Post National Historic Site, p. 15). This area surrounds a trail called the Forest Loop, which we used to access the site. The area is relatively devoid of ponds although there are some good wetland sites that should support some amphibians. The area is thickly overgrown with stinging nettle (*Urtica dioica*) which we understand is being cleared (communication with park staff).

Effort expended in each habitat type is given in table 10 (p. 45).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 11 (p. 46) lists the species that were expected from Knife River and the species we found there. We found 0.16 specimen/person-hour on VES conducted in 2002 and 1.03 specimens/person-hour on VES conducted in 2003 on Knife River Indian Villages National Historic Site. We also list species that we think should be found at the park given our results in table 11(p. 46).

We think species richness at Knife River Indian Villages National Historic Site is probably 12 species, although we found only five species. Species richness at the site could range as high as 14 species. We found 41.7% of the species we expected to find.

As in most park units of the northern Great Plains, the site is not species-rich. Most of the species that we did not observe are either rare or rarely observed. These species include the tiger salamander (terrestrial adults are seldom observed and suitable breeding ponds could not be found; no prairie dog towns were found on the park), the Great Plains toad and Plains spadefoot (both only come out in heavy rains), and the western hog-nosed snake (which may not be found on the park). We did not observe relatively common species such as the painted turtle, bullsnake, and yellow-bellied racer. We also did not observe common snapping turtles but they do not bask as much as painted turtles and can be difficult to find.

We have only slightly altered the table of species expected to occur on the park (table 11, p. 46). Although the site is within the range of the western hog-nosed snake we did not find what we thought was suitable habitat for this snake on the park. We have changed the status of the western hog-nosed snake to reflect this conclusion. The smooth green snake is found nearby the park and is a species of wetter areas, such as smaller creeks and streams. It could possibly occur on the park unit.

Moore et al. (1989) gave a list of amphibians and reptiles from Knife River but it is not clear exactly how this list was constructed. It appeared to us that they relied on park staff to construct the list, but it was not clear that Moore and co-workers attempted to search for herpetofauna on the park. They also made what appeared to us to be errors in judgment to construct their list of herpetofauna expected on the park. We have largely discounted their report.

Recommendations to Park Management

The Forest Loop area has abundant vegetation and forest and some wetland areas suitable for amphibians and reptiles. We again advise that wetland sites be left as little altered as possible. A major problem here is the extensive stinging nettle growth in the forest. Park staff is aware of the problem and is working to clear the area of stinging nettle. There are no studies on how stinging nettle affects herpetofauna. Considerable manipulation, including burning, is planned for the Forest Loop area. We do not know how most of the manipulations (cutting of trees seems the most common manipulation being undertaken at this time) will affect the herpetofauna. Studies have shown that burning benefits herpetofauna (deMaynadier and Hunter, 1995; Russell et al., 1999), but burning can kill amphibians and reptiles outright when conducted in the wrong season. It would seem like the best season to burn would follow the breeding season and dispersal season (spring and early summer), when many young amphibians are moving throughout the region. Burning should be done cautiously around wetlands. We would recommend that burns be scheduled late in the season; perhaps in September or October. If this is not possible, care should be taken not to burn too close to wetlands. A core area of 164 m around each wetland is thought to conserve 95% of the population of resident ambystomatid salamanders (Semlitsch, 1998). This may be a reasonable core area to conserve amphibians, but Semlitsch (1998) is one of the few studies to look at the issue of core areas around ponds and he looked at a single family of salamanders.

At Knife River the banks of the Missouri River are generally very steep with relatively few ponds and little pond diversity. The Woodhouse's toad seemed to be very common along the river but due to the high bluffs and general inaccessibility of this part of the park at night we could not determine exactly where the ponds were that these toads were calling from. We would recommend conservation of wetland areas found along the river but we did not find a great number or diversity of ponds near the river.

The only species that the park should consider monitoring would be the northern leopard frog due to its status within North America. However, northern leopard frogs did not seem abundant at Knife River Indian Villages National Historic Site. Although we do not expect them to occur there, two snakes of interest would be the western hog-nosed snake and the smooth green snake. Observations of either of these species on the park would be notable.

Vouchers Collected and Repository

No voucher specimens were collected at Knife River Indian Villages National Historic Site.

MOUNT RUSHMORE NATIONAL MEMORIAL

Abstract

We found 0.67 specimen/person-hour on VES conducted in 2002 and 0.62 specimen/person-hour on VES conducted in 2003 at Mount Rushmore National Monument. We found four of the eight species we expected to occur at Mount Rushmore, or 50% of the expected species. Starling Basin is found on the park; it is one of the more important wetland areas we have found in the Black Hills. A beaver dam was found at this site and this has probably created the relatively diverse mix of wetlands found at this small area. It is one of the few areas we have found in the Black Hills with an active beaver dam and it needs to be actively monitored. We believe that wetland sites with beaver dams are probably very important sites for herpetofauna anywhere in the northern Great Plains region. We found little evidence of visitor damage to this site. Visitor activity is primarily restricted to the area immediately below Mount Rushmore. We saw no other major management issues on the park.

Introduction and Methods

Mount Rushmore National Monument consisted of a single habitat type, ponderosa pine forest. This habitat type has been described previously. There were two wetland areas on the park, Starling Basin and Lafferty Gulch.

Starling Basin was the best of these sites. It consisted of a small creek and associated wetland area augmented by a beaver (*Castor canadensis*) pond. Beaver are uncommon in the Black Hills (Turner, 1974) and we recognized that the Starling Basin site could be important. We also visited Lafferty Gulch, but found a small stream surrounded with large boulders with no ponded water. We conducted all of our call surveys and VES at these sites.

Effort expended in each habitat type is given in table 12 (p. 46).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 13 (p. 47) lists the species that we expected at Mount Rushmore and the species we found there. We found 0.67 specimen/person-hour on VES conducted in 2002 and 0.62 specimen/person-hour on VES conducted in 2003 at Mount Rushmore National Monument. We also list species that we think should be found at the park given our results (table 13).

We found four species at Mount Rushmore and we feel confident that species richness is eight species. However, park staff reported an observation of the prairie rattlesnake at the park. We could not verify this report but prairie rattlesnakes have been reported from areas like Mount Rushmore in the Black Hills (Peterson, 1974; Smith et al., in preparation). It would also seem that prairie rattlesnakes would seldom be misidentified in the field. However, we have discounted this record and list prairie rattlesnakes as a species that possibly occurs on the park. We found 50% of the species we expected to find on the park.

As we found at most park sites, common species were relatively easy to find and considerable effort needs to be expended to find other species. Two of the species we did

not find are rarely observed (terrestrial tiger salamanders) or rare (pale milk snake). Two other species common in selected habitats (redbelly snake, smooth green snake) were not found. Both species have restricted activity periods and can on occasion be hard to find. Both are semi-fossorial and may not be observed when they are active. We also did not find larval tiger salamanders, but we did not find suitable water sources for them.

We were most impressed with the Starling Basin area. A beaver dam at the area has created a good wetland site suitable for several species of herpetofauna, including northern leopard frogs, garter snakes, smooth green snakes, and redbelly snakes. We thought this was the most important herpetofaunal habitat on the park, and one of the nicer wetland sites we have found in the Black Hills.

Recommendations to Park Management

The Starling Basin area was the most productive and herpetofaunally diverse site on the park. The area should be preserved in its natural state. Most importantly, the beaver pond was particularly diverse, but conservation of the entire drainage is important. Beaver are rare in the Black Hills (Turner, 1974; Parrish et al., 1996) but should create excellent habitat for amphibians and reptiles. We did not find other areas on the park that we thought were particularly important to conserve populations of reptiles and amphibians. We cannot overemphasize the importance of Starling Basin. In eight years of field work in the Black Hills region, one of us (Smith) has found less than ten beaver dams, and fewer than five in the Black Hills.

We would suggest monitoring the Starling Basin area. Call surveys could probably be used to determine the presence or absence of northern leopard frogs in the basin on a yearly basis, although VES might be more effective for this purpose. Garter snake surveys in Starling Basin could also be effective in monitoring the presence or absence of the two species found at the park, the wandering and red-sided garter snake. See "Monitoring", pp. 30-31, for monitoring suggestions.

Species of special interest on the park are the northern leopard frog, because of their imperiled status across their range (as we have discussed before), and the pale milk snake, which we have noted is rare or rarely observed in the northern Great Plains and Black Hills regions.

We saw no particular impacts on the Starling Basin site. It is removed from roads and seemed to us to receive light visitation, although park staff could better assess visitation at Starling Basin. Horses are allowed onto the trail leading into Starling Basin and they could cause erosion within the basin that might harm herpetofauna. However, we did not notice significant damage from horses in the area.

The monument is probably amongst the most heavily visited park units in the country, but visitors limit their activity to the base of Mount Rushmore. We think this does relatively little harm to the herpetofauna at the park, given the paucity of wetlands present at Mount Rushmore. Starling Basin seems relatively removed from the heavy visitation of the park.

Vouchers Collected and Repository

No voucher specimens were collected at Mount Rushmore National Memorial.

SCOTT'S BLUFF NATIONAL MONUMENT

Abstract

We found 0.36 specimen/person-hour on VES conducted in 2002 and 1.26 specimens/person-hour on VES conducted in 2003 at Scott's Bluff National Monument. We expected to find 21 species at the park and found 12 of these, or 57.1% of the species we expected to find. Species richness could be as high as 25 species. The riparian area along the North Platte River has a diverse mix of habitats that support many different species of herpetofauna. We thought it was one of the most diverse areas we studied during this project. We recommend conserving this area by leaving it in as natural a state as possible. Pond diversity should be maintained and we saw no reason to alter the vegetation in this area. We recommend prescribed burns on a relatively natural burning schedule. Prairie rattlesnakes were found in the riparian area and we suspect that there is probably a den somewhere on the park, perhaps on the bluff itself. This densite needs to be found and monitored.

Introduction and Methods

The three habitat types that we surveyed at Scotts Bluff National Monument were the riparian strip along the North Platte River, badlands topography, and a grassland of the Central Shortgrass Prairie vegetation type (Johnson and Larson, 1999), previously described (see "Fort Laramie National Historic Site", p. 12). The riparian area at Scotts Bluff was particularly wide and densely vegetated. There was also high diversity of ponds in the riparian area and generally good habitat for reptiles and amphibians. We also surveyed the Gering Canal on the park. This irrigation ditch was one of the few sources of temporary water on the park during our surveys other than the riparian strip.

The badlands habitat at Scotts Bluff National Monument is typical of badlands topography found throughout western North Dakota, South Dakota, and Nebraska. Badlands topography is formed through erosion of a relatively soft layer of sediment, the White River Group, forming haystack buttes and pinnacle (sharply pointed) buttes throughout the area (Gries, 1996). Scott's Bluff is an example of one of the larger buttes found in the region. The steep slopes of badlands formations typically have little or no vegetation. Rocky Mountain juniper (*Juniperus scopulorum*) is found in some of the wetter draws.

Although not considered a special habitat type at Scott's Bluff, we conducted salamander surveys at the prairie dog town on the park. We eventually encountered salamanders on the prairie dog town at which point we stopped salamander surveys.

Effort expended in each habitat type is given in table 14 (p. 47).

Results and Discussion

Raw data are attached in the accompanying excel file. Table 15 (p. 48) lists the species that were expected at Scott's Bluff and the species we found there. We found 0.36 specimen/person-hour on VES conducted in 2002 and 1.26 specimens/person-hour on VES conducted in 2003 at Scott's Bluff National Monument. We also list species that we think should be found at the park given our results (table 15).

Scott's Bluff National Monument was the most species-rich park unit we surveyed, likely to have 21 species and possibly as many as 25 species. As on most park units in this study, we found relatively few of these species. Ten of the species we found are relatively easy to find; the eleventh (the tiger salamander) is easy to find at prairie dog towns. Scott's Bluff had a large prairie dog town so salamander surveys worked well to find tiger salamanders. We found a Plains spadefoot about 10 m south of the south entrance to the park along the Gering Canal. We recorded this specimen as a park observation, bringing to 12 the number of species we found on the park. We found 57.1% of the species we expected to find.

The species we did not observe are rare or cryptic (*Eumeces multivirgatus*, the many-lined skink; *E. obsoletus*, the Great Plains skink; the greater short-horned lizard; the western hog-nosed snake; and the pale milk snake) or require special weather conditions (the Great Plains toad). Four species that might occur on the park are typically easily observed; the six-lined racerunner, the northern sagebrush lizard, the eastern fence lizard (*Sceloporus undulatus*), and the lesser earless lizard (*Holbrookia maculata*). We believe that they probably do not exist on the park, although Scott's Bluff is within the range of these species. All these species should be easy to find; we did not find them and park staff did not indicate that lizards had ever been found on the park. Other species we expected to find, the painted turtle and the common snapping turtle, were not found. It is possible that we did not find the Plains garter snake because it may be excluded from the site by the red-sided garter snake.

Recommendations to Park Management

We thought that the riparian area on the bank of the North Platte River offered a particularly diverse mix of habitats for herpetofauna. The diversity of ponds should be maintained here and a natural mix of vegetation should be fostered. If these management actions require prescribed burning we believe this would probably benefit herpetofauna on the park (deMaynadier and Hunter, 1995; Russell et al., 1999).

The riparian habitat could be monitored for northern leopard frogs and garter snakes, as in many other park units in this study (see "Monitoring", pp. 30 – 31). As part of a regionwide park service effort this kind of monitoring initiative could help to gauge the health of these species across a wide range of parks in the northern Great Plains. Both species might be used as indicators of water quality in the riparian habitat. Another important point about the riparian habitat is that the pond types in this area are relatively varied. They could support a variety of amphibians, including the northern leopard frog, boreal chorus frog, Woodhouse's toad, and tiger salamander.

Another issue on the park is the Gering Canal running along the western edge of the park above the riparian area. This irrigation ditch probably cannot be managed for wildlife since it is obviously a man-made structure, but depressions in the ditch during the years of this study proved to be another one of the relatively rare wetlands available for reproduction. During the late spring and early summer hundreds of boreal chorus frog tadpoles were found in this ditch. However, irrigation ditches are man-made structures and boreal chorus frogs were common on all parks.

Another wetland site that may be important for herpetofauna on the park is Scott's Spring. On a single VES, we found more yellow-bellied racers in the vicinity of this spring than we found on any VES in the study, save one, which was also conducted on

Scott's Bluff National Monument. The spring may be rich with food items for the racers and may have other herpetofauna that we did not find. Yellow-bellied racers seemed to be more abundant at Scott's Bluff than at any other park we studied.

Ornate box turtles (*Terrapene ornata*) were also found at Scott's Bluff. They have declined in Nebraska (Fogell, personal communication) and may be of conservation interest. We would recommend that park staff keep records of observations of this species.

Other important species are those typical of the park units we studied; greater short-horned lizards, western hog-nosed snakes, and the pale milk snake. To add to this list of seldom-observed herpetofauna, records of the Great Plains skink and the many-lined skink would be of note.

We saw little chance for visitors to negatively affect herpetofauna. Roadways run around the edges of the park and most visitation is localized to the visitors center. One road runs to the top of the butte, but we did not find dead herpetofauna on this road. However, the Saddle Rock Trail passes directly by Scott's Spring and there is a potential for damage to this spring. Park management should monitor the spring site to be alert to damage caused by visitors that might leave the trail in this area and trample the site. The trail should probably be relocated upslope from the spring.

Of further interest at the park, prairie rattlesnakes move from higher slopes where they overwinter into lowland areas where they feed (Duvall et al., 1990). We found prairie rattlesnakes in the riparian strip along the North Platte River and they may be moving into this site during the spring to spend the active season (perhaps June to September) to forage. There is probably a den on the park, perhaps on Scott's Bluff itself. This den should be found and conserved. Park staff and visitors should be warned that prairie rattlesnakes could be common in the riparian area and should take proper precautions. Encounters with prairie rattlesnakes in this area are particularly problematic because of the dense vegetation in the riparian zone. As we have mentioned before, Reinert and Rupert (1999) found that translocated timber rattlesnakes were five times more likely to die as non-translocated individuals. We do not recommend moving "problem" snakes.

Vouchers Collected and Repository

No voucher specimens were collected at Scott's Bluff National Monument.

CONCLUSIONS AND MONITORING

In general we found that the parks of the northern Great Plains that we studied contained the common species that we expected to find. We found few reasons to be concerned that the conditions on the parks were degraded enough to affect most herpetofauna. For virtually all parks we had trouble finding rare species and usually recommended that park staff keep records of these species if found. Most often these species were the greater short-horned lizard, the western hog-nosed snake, and the pale milk snake. Other species may be of greater or lesser importance, depending on the park unit, as we have pointed out. We only rarely found species that come out to breed only after heavy rainstorms, such as Plains spadefoots and Great Plains toads. Park staff should seek these species on evenings after such rainfall events. This is probably the only way to determine if they occur on these parks, and we suspect they should occur on these parks. We were not lucky enough to be on any park during heavy rains.

At the regional level a permanent monitoring plan should be considered. One to three sites could be established at several parks as permanent survey sites to monitor the northern leopard frog across the region. The northern leopard frog is considered to be of conservation concern across much of the country (see Stebbins and Cohen, 1995, and Smith, 2003, for reviews) and a regional monitoring effort would be worthwhile on the northern Great Plains parks. At any one park the data might be difficult to interpret and it would be difficult to draw conclusions from any one park. However, if a few ponds are monitored at parks where we found suitable ponds (mentioned above under each park account), it would be possible to obtain a region-wide picture of the status of this species in the northern Great Plains. Considering other parks within the region, such as Agate Fossil Beds National Monument, Badlands National Park, Theodore Roosevelt National Park, and Wind Cave National Park, a truly comprehensive long-term study of the status of this declining species could be undertaken. Financial support from the Amphibian Research and Monitoring Initiative (ARMI) could assist in this process.

A major problem with this study was long-term drought in the region. Every site had undergone drought for several years (figures 1-7, pp. 37 – 40). Many wetlands did not fill with water in 2002 or 2003. In some areas VES were conducted in high winds and very hot weather, which was typical throughout much of the time that the study was conducted. We feel that weather seriously affected our results even though we found common species at all sites. We might have been able to find more uncommon species if the weather had been less inclement. If funding is available we would recommend further studies under better weather conditions.

A major problem with any inventory is finding rare species or species that occur only under special conditions. In this study Great Plains toads and Plains spadefoots were rarely encountered because they only come out after heavy rains. In addition, various rare species, such as greater short-horned lizards, western hog-nosed snakes, and pale milk snakes, were not found. We believe it is important to train park staff, perhaps seasonal employees, to identify these species, most of which are easily identified. Staff could survey the parks during appropriate weather conditions for the toads. With consultation from trained herpetologists, drift fences could be constructed that could be monitored by park staff to find rare species. We believe that it could take months and sometimes years to find some of these species.

Monitoring

Monitoring and abundance studies are possibly the most important need for any area to assess trends in presence and absence or abundance of any species. Because many species of herpetofauna are difficult to monitor, we suggest studies on the following species. We also suggest how these studies might be designed.

Acoustic monitoring of frogs and toads: Many frogs and toads can be monitored using call surveys (Berrill et al., 1992; Peterson and Dorcas, 1994; Zimmerman, 1994; Bishop et al., 1997; Bonin et al., 1997; Lepage et al., 1997; Johnson, 1998; Mossman et al., 1998). We are especially concerned about northern leopard frogs because they have declined or become extinct across much of their range. Reviews of many studies on the decline of northern leopard frogs are found in Stebbins and Cohen (1995) and Smith (2003). Northern leopard frogs are also susceptible to diseases that may cause amphibian declines (Carey et al., 1999; Daszak et al., 1999). Although we found no strong evidence of declines of the northern leopard frog on the parks we studied, we would strongly suggest monitoring the species. It may be difficult to monitor this species using calling surveys in the northern Great Plains because northern leopard frog calling behavior is sporadic and difficult to hear. Presence/absence monitoring using VES might be a better monitoring technique on the parks we inventoried. We think the following parks that we studied might be suitable for monitoring northern leopard frogs: Fort Laramie National Historic Site (one or two ponds); Fort Union Trading Post National Historic Site (one or two ponds); Mount Rushmore National Memorial (Starling Basin); and Scott's Bluff National Monument (three or four ponds). We also suggest more extensive monitoring on the larger parks of the region (Badlands National Park and Theodore Roosevelt National Park) and investigation of Agate Fossil Beds National Monument for suitable monitoring sites. We would suggest a pilot project to identify monitoring locations on several parks and to determine the best technique to monitor northern leopard frogs in the northern Great Plains. We think a region-wide effort involving many parks, possibly with funding from the Amphibian Research and Monitoring Initiative, could be used to assess the status of the northern leopard frog in the northern Great Plains.

Garter snake monitoring: Any of the garter snakes would be suitable for monitoring and abundance studies because they are one of the few snakes that are relatively common and fairly easy to find. Because they prey heavily on amphibians, garter snakes may decline as amphibians decline (Gibbons et al., 2000). A study of garter snakes would also be of interest simply to observe any declines in the abundance of these snakes since snake declines have not been extensively studied. Garter snakes can be monitored using VES at appropriate wetland sites. Park staff could perform this function although it is difficult to separate the Plains garter snake and red-sided garter snake. With training, park staff should have no problem identifying and monitoring these snakes. We think that it would also be possible to gather meaningful relative abundance figures for these species. Garter snakes could be monitored on any park in the northern Great Plains. Once again we recommend a region-wide effort instead of intense study on a single park.

Densite monitoring of prairie rattlesnakes: Prairie rattlesnakes could be monitored at Devil's Tower and Scott's Bluff National Monuments, but it would be necessary to find

densites. Snakes would be relatively easy to monitor at densites because densites can be surrounded by drift fences or traps in the spring and fall during egress and ingress. Specimens can be marked, measured, and weighed to develop a relatively complete picture of the health of these populations. Other species of snakes hibernate with this species (Graves and Duvall, 1990), and species that we had trouble finding, like the western hog-nosed snake and milk snakes (*Lampropeltis* species), have also been found hibernating with the prairie rattlesnake (Klauber, 1972). In addition, larger snakes such as yellow-bellied racers and bullsnakes are commonly found hibernating with prairie rattlesnakes (Klauber, 1972). Prairie rattlesnakes also range widely (Duvall et al., 1990; King and Duvall, 1990) and it might be possible to use prairie rattlesnakes as indicator species at Devil's Tower and Scott's Bluff to assess the impacts of management decisions and urban impacts (at Scott's Bluff) on larger terrestrial snakes, like bullsnakes and yellow-bellied racers. We know of no other snake that is not habitually found around water sources that might be relatively easy to monitor.

General strategy: We suggest a monitoring strategy throughout the parks of the northern Great Plains that would consist of three basic parts. In order of decreasing importance, they are:

1) Monitoring the presence and absence of northern leopard frogs at representative locations on several parks.

2) Monitoring the status of all garter snake species on every park, depending on resources available.

3) Densite monitoring to assess the health of prairie rattlesnakes and other snakes associated with this species. For the parks we studied this is probably possible only on Devil's Tower and Scott's Bluff National Monuments.

Citations

Ashley, E. P., and J. T. Robinson. 1996. Road mortality of amphibians, reptiles, and other wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field Naturalist 110:403-412.

Baxter, G. T., and M. D. Stone. 1985. Amphibians and Reptiles of Wyoming, 2nd ed. Wyoming Game and Fish Department, Cheyenne, Wyoming.

Beever, E. A., and P. F. Brussard. 2004. Community- and landscape-level responses of reptiles and small mammals to feral-horse grazing in the Great Basin. Journal of Arid Environments 59:271-297.

Berrill, M., S. Bertram, D. Brigham, and V. Campbell. 1992. A comparison of three methods of monitoring frog populations. Pp. 87-93 in Bishop, C. A., and K. E. Pettit, eds. Declines in Canadian Amphibian Populations: Designing a National Monitoring Strategy. Occasional Paper Number 76, Canadian Wildlife Service, Ottawa, Ontario.

Bishop, C. A., K. E. Pettit, M. E. Gartshore, and D. A. MacLeod. 1997. Extensive monitoring of anuran populations using call counts and road transects in Ontario (1992 to 1993). Pp. 149-160 in Green, D. M, ed. Amphibians in Decline: Canadian Studies of a Global Problem. Herpetological Conservation, Number One. Society for the Study of Amphibians and Reptiles, Saint Louis, Missouri.

Bogan, M. A., and C. A. Ramotnik. 1994. Baseline surveys for mammals at Jewel Cave National Monument, South Dakota. Unpublished report submitted to the National Park Service.

Bonin, J., M. Ouellet, J. Rodrigue, J. L. DesGranges, F. Gagné, T. F. Sharbel, and L. A. Lowcock. 1997. Measuring the health of frogs in agricultural habitats subjected to pesticides. Pp. 246-257 in Green, D. M, ed. Amphibians in Decline: Canadian Studies of a Global Problem. Herpetological Conservation, Number One. Society for the Study of Amphibians and Reptiles, Saint Louis, Missouri.

Carey, C., N. Cohen, and L. Rollins-Smith. 1999. Amphibian declines: An immunological perspective. Developmental and Comparative Immunology 23:459-472.

Cope, E. D. 1900. The crocodilians, lizards, and snakes of North America. Report of the United States National Museum 1898:153-1270.

Corn, P. S. 1994. Straight-line drift fences and pitfall traps. Pp. 109-117 *in* Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L.-A. C. Hayek, and M. S. Foster, eds. Smithsonian Institution Press, Washington, D. C.

Crump, M. L., and N. J. Scott, Jr. 1994. Visual encounter surveys. Pp. 84-92 *in* Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L.-A. C. Hayek, and M. S. Foster, eds. Smithsonian Institution Press, Washington, D. C.

Daszak, P., L. Berger, A. A. Cunningham, A. D. Hyatt, D. E. Green, and R. Speare. 1999. Emerging infectious diseases and amphibian population declines. Emerging Infectious Diseases 5:735-748.

deMaynadier, P. G., and M. L. Hunter, Jr. 1995. The relationship between forest management and amphibian ecology: A review of the North American literature. Environmental Review 3:230-261.

Duvall, D., M. J. Goode, W. K. Hayes, J. K. Leonhardt, and D. G. Brown. 1990. Prairie rattlesnake vernal migration: Field experimental analyses and survival value. National Geographic Research 6:457-469.

Gibbons, J. W., D. E. Scott, T. J. Ryan, K. A. Buhlmann, T. D. Tuberville, B. S. Metts, J. L. Greene, T. Mills, Y. Leiden, S. Poppy, and C. T. Winne. 2000. The global decline of reptiles, déjà vu amphibians. Bioscience 50:653-666.

Graves, B. M., and D. Duvall. 1990. Spring emergence patterns of wandering garter snakes and prairie rattlesnakes in Wyoming. Journal of Herpetology 24:351-356.

Gries, J. P. 1996. Roadside Geology of South Dakota. Mountain Press Publishing Company, Missoula, Montana.

Homyack, J. D., and W. M. Giuliano. 2002. Effect of streambank fencing on herpetofauna in pasture stream zones. Wildlife Society Bulletin 30:361-369.

Jansen, A., and M. Healey. 2003. Frog communities and wetland condition: Relationships with grazing by domestic livestock along an Australian floodplain river. Biological Conservation 109:207-219.

Johnson, J. R., and G. E. Larson. 1999. Grassland Plants of South Dakota and the Northern Great Plains. South Dakota State University College of Agriculture and Biological Sciences, Brookings, South Dakota.

Johnson, T. R. 1998. Missouri toad and frog calling survey: The first year. Pp. 357-359 in Lannoo, M. J., ed. Status and Conservation of Midwestern Amphibians. University of Iowa Press, Iowa City, Iowa.

King, M. B., and D. Duvall. 1990. Prairie rattlesnake seasonal migrations: Episodes of movement, vernal foraging, and sex differences. Animal Behaviour 39:924-935.

Klauber, L. M. 1972. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind, 2nd ed. University of California Press, Berkeley, California.

Kolbe, J. J., B. E. Smith, and D. M. Browning. 2002. A large aggregation of tiger salamanders (*Ambystoma tigrinum melanostictum*) at a black-tailed prairie dog (*Cynomys ludovicianus*) town in southwestern South Dakota. Herpetological Review 33:95-99.

Kretzer, J. E., and J. F. Cully, Jr. 2001. Effects of black-tailed prairie dogs on reptiles and amphibians in Kansas shortgrass prairie. Southwestern Naturalist 46:171-177.

Lepage, M., R. Courtois, C. Daigle, and S. Matte. 1997. Surveying calling anurans in Québec using volunteers. Pp. 128-140 in Green, D. M., ed. Amphibians in Decline: Canadian Studies of a Global Problem. Herpetological Conservation Number One. Society for the Study of Amphibians and Reptiles, St. Louis, Missouri.

Moore, R. E., W. R. Gould, and R. K. Moore. 1989. A survey of the vertebrate resources of the Knife River Indian Villages National Historic Site. Unpublished report submitted to the National Park Service.

Mossman, M. J., L. M. Hartman, R. Hay, J. R. Sauer, and B. J. Dhuey. 1998. Monitoring long-term trends in Wisconsin frog and toad populations. Pp. 169-198 in Lannoo, M. J., ed. Status and Conservation of Midwestern Amphibians. University of Iowa Press, Iowa City, Iowa.

Parrish, J. B., D. J. Herman, and D. J. Reyher. 1996. A Century of Change in Black Hills Forest and Riparian Ecosystems. U.S. Forest Service Agricultural Experiment Station, U.S. Department of Agriculture. South Dakota State University. No. B722.

Peterson, C. R. 1974. A preliminary report on the amphibians and reptiles of the Black Hills of South Dakota and Wyoming. M. S. Thesis, University of Illinois at Urbana-Champaign.

Peterson, C. R., and M. E. Dorcas. 1994. Automated data acquisition. Pp. 47-57 in Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster, eds. Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington, D. C.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C.

Platt, D. R. 1969. Natural history of the hognose snakes *Heterodon platyrhinos* and *Heterodon nasicus*. University of Kansas Publications Museum of Natural History 18:253-420.

Reaser, J. K. 2000. Demographic analysis of the Columbia spotted frog (*Rana luteiventris*): Case study in spatiotemporal variation. Canadian Journal of Zoology 78:1158-1167.

Reinert, H. K., and Rupert, R. R., Jr. 1999. Impacts of translocation on behavior and survival of timber rattlesnakes, *Crotalus horridus*. Journal of Herpetology 33:45-61.

Russell, K. R., D. H. Van Lear, and D. C. Guynn, Jr. 1999. Prescribed fire effects on herpetofauna: Review and management implications. Wildlife Society Bulletin 27:374-384.

Semlitsch, R. D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1113-1119.

Shaffer, H. B., and J. E. Juterbock. 1994. Night driving. Pp. 163-166 *in* Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L.-A. C. Hayek, and M. S. Foster, eds. Smithsonian Institution Press, Washington, D. C.

Sharps, J. C., and D. W. Uresk. 1990. Ecological review of black-tailed prairie dogs and associated species in western South Dakota USA. Great Basin Naturalist 50:339-346.

Sherbrooke, W. C. 2003. Introduction to Horned Lizards of North America. California Natural History Guides No. 64. University of California Press, Berkeley, California.

Smith, B. E. 2003. A conservation assessment of the northern leopard frog (*Rana pipiens*) in the Black Hills of South Dakota and Wyoming. Black Hills National Forest, U. S. Forest Service.
http://www.fs.fed.us/r2/blackhills/projects/planning/assessments/leopard_frog.pdf

Smith, B. E., J. J. Kolbe, and R. S. Ferguson. 1998. A herpetological survey of Wind Cave National Park, South Dakota. Unpublished report submitted to the Northern Prairie Wildlife Research Center, U.S. Geological Survey, Biological Resources Division. Jamestown, North Dakota.

Smith, B. E., C. R. Peterson, L. R. Cottingham, and M. Goode. In preparation. A herpetofaunal survey of the Black Hills, summer 2004. Unpublished report submitted to the South Dakota Game, Fish, and Parks Department.

Stebbins, R. C. 2003. A Field Guide to Western Reptiles and Amphibians, 3rd ed. Houghton Mifflin Company, New York, New York.

Stebbins, R. C., and N. W. Cohen. 1995. A Natural History of Amphibians. Princeton University Press. Princeton, New Jersey.

Turner, R. W. 1974. Mammals of the Black Hills of South Dakota and Wyoming. University of Kansas Museum of Natural History Miscellaneous Publication 60:1-178.

Tyler, J. D., and J. S. Shackford. 2002. Vertebrate associates of black-tailed prairie dogs in Oklahoma. Proceedings of the Oklahoma Academy of Science 82:41-47.

Zimmerman, B. 1994. Audio strip transects. Pp. 92-97 in Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek, and M. S. Foster, eds. Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington, D. C.

FIGURES AND TABLES

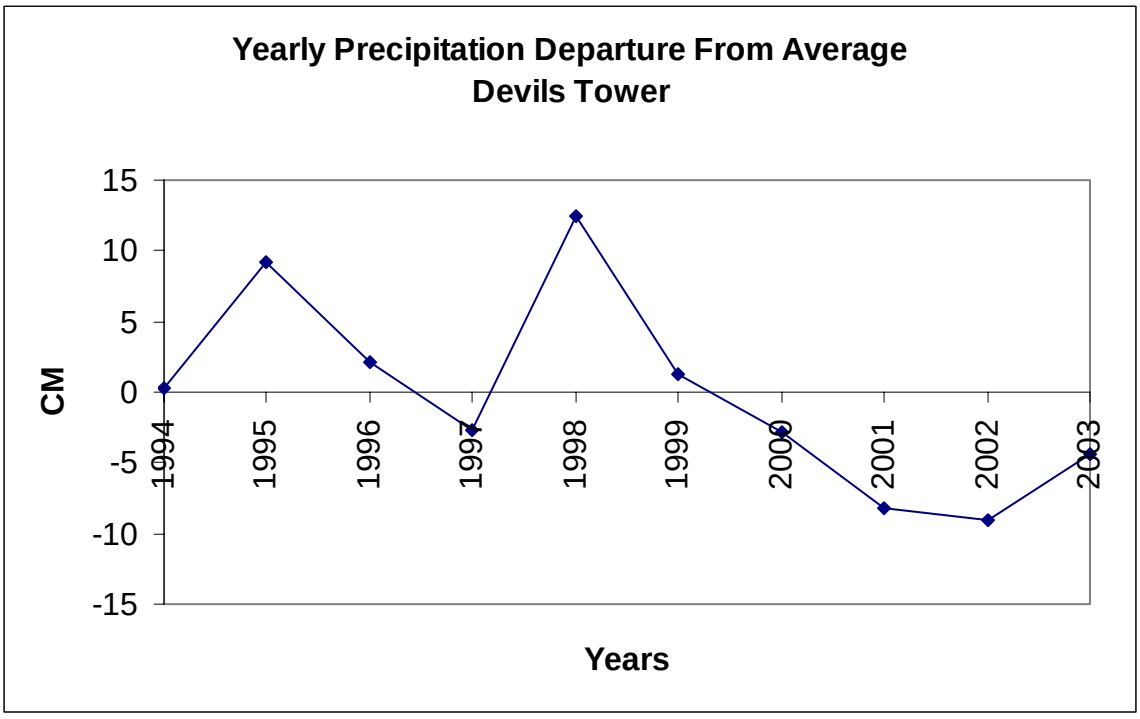

Figure 1: Departure from average precipitation at Devil's Tower National Monument, 1994 – 2003.

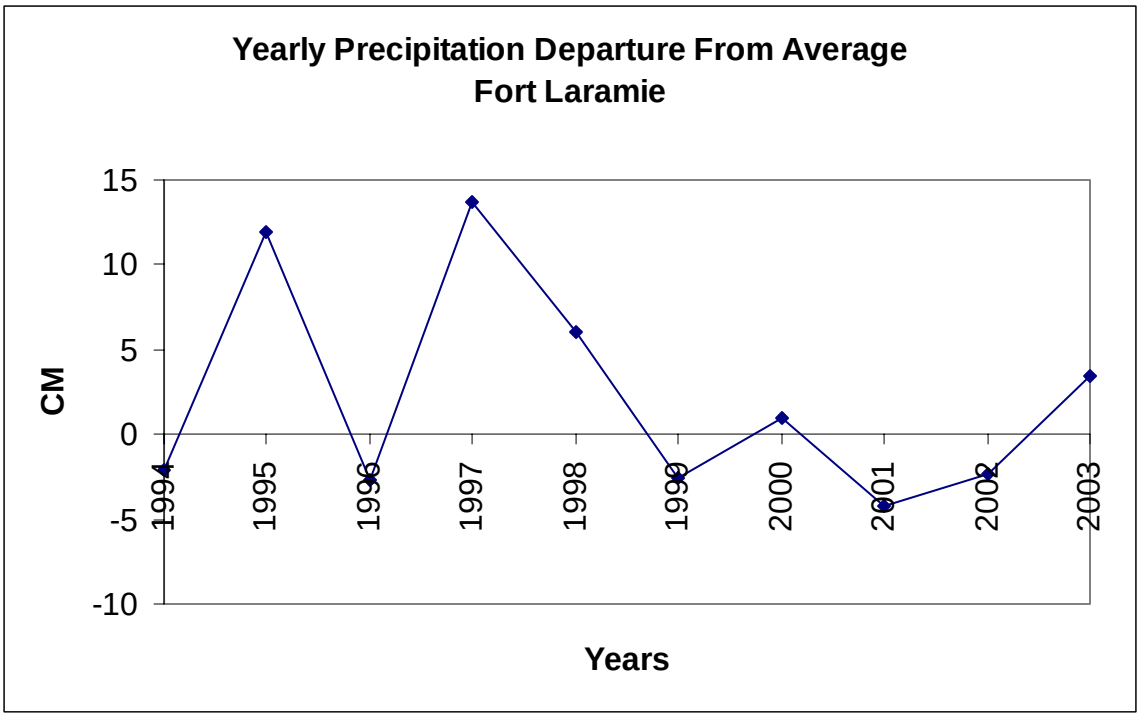

Figure 2: Departure from average precipitation at Fort Laramie National Historic Site, 1994 – 2003.

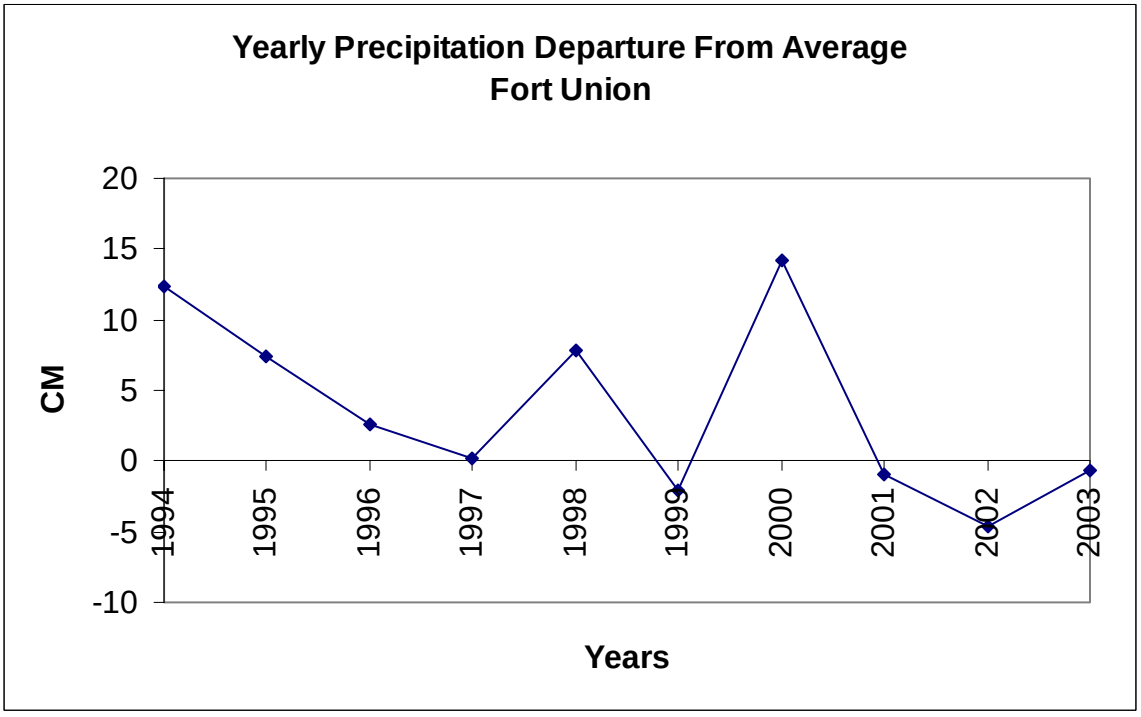

Figure 3: Departure from average precipitation at Fort Union Trading Post National Historic Site, 1994 – 2003.

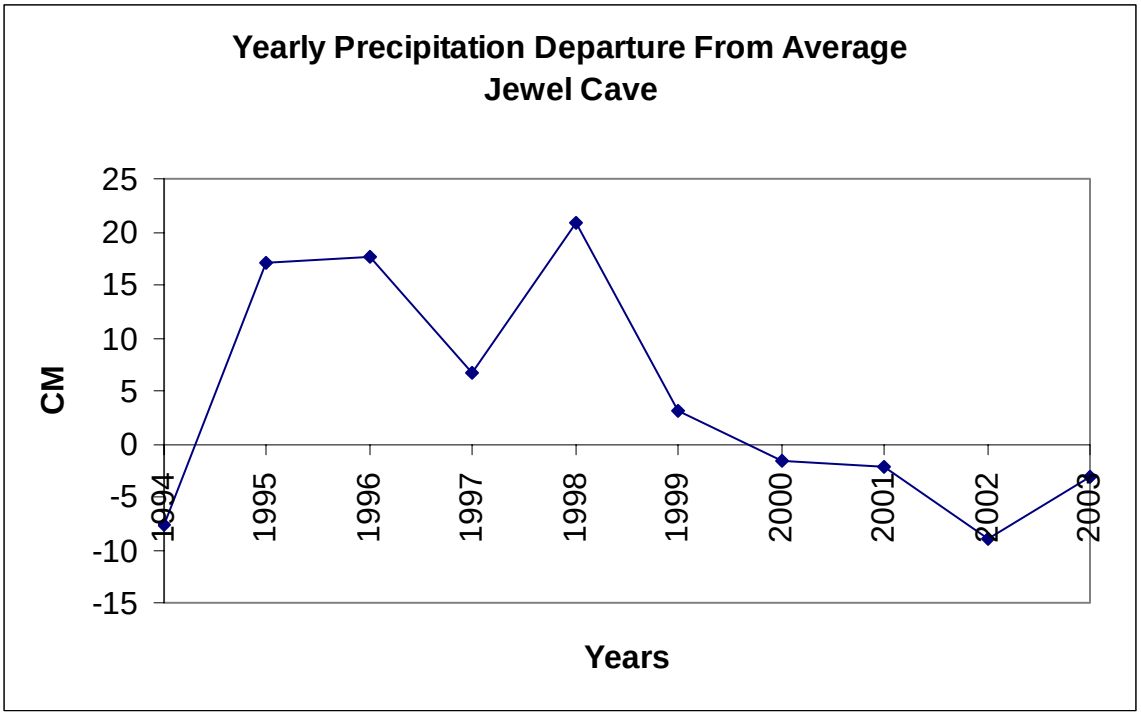

Figure 4: Departure from average precipitation at Jewel Cave National Monument, 1994 – 2003.

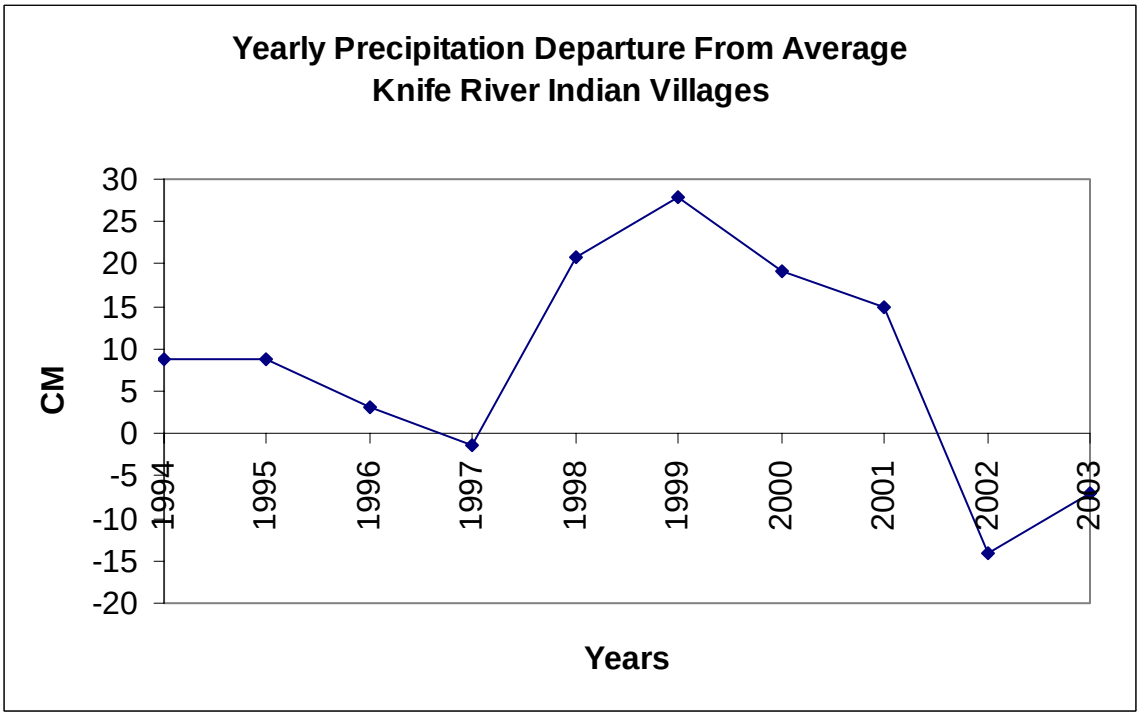

Figure 5: Departure from average precipitation at Knife River Indian Villages National Historic Site, 1994 – 2003.

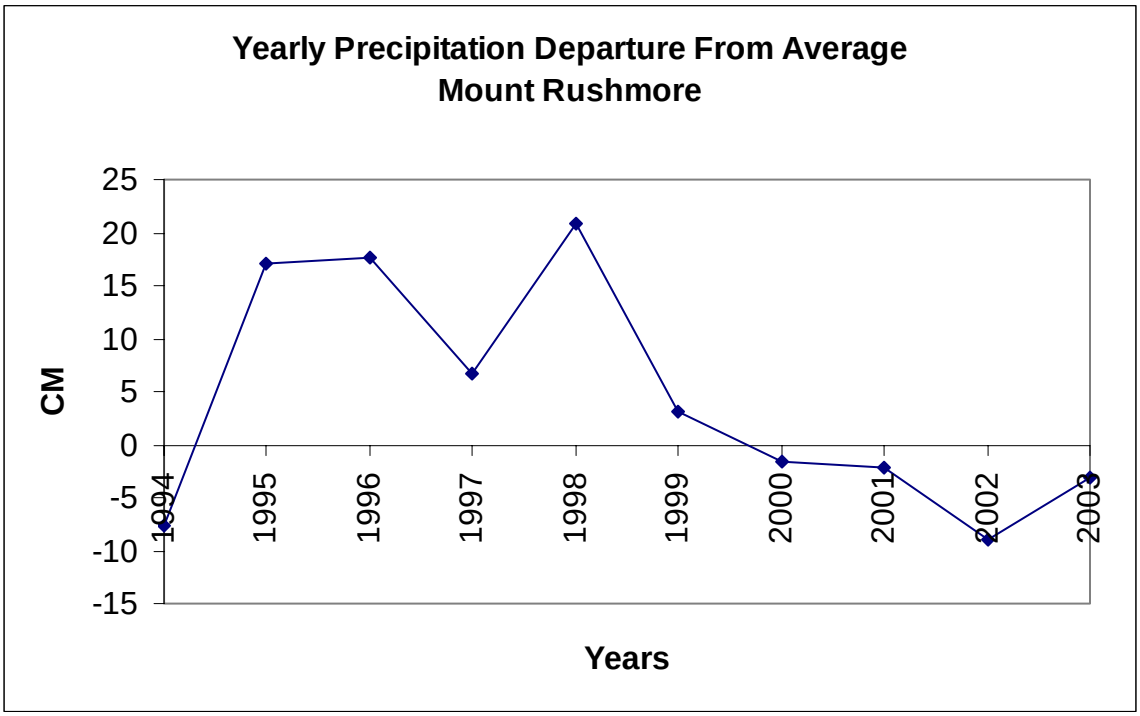

Figure 6: Departure from average precipitation at Mount Rushmore National Monument, 1994 – 2003.

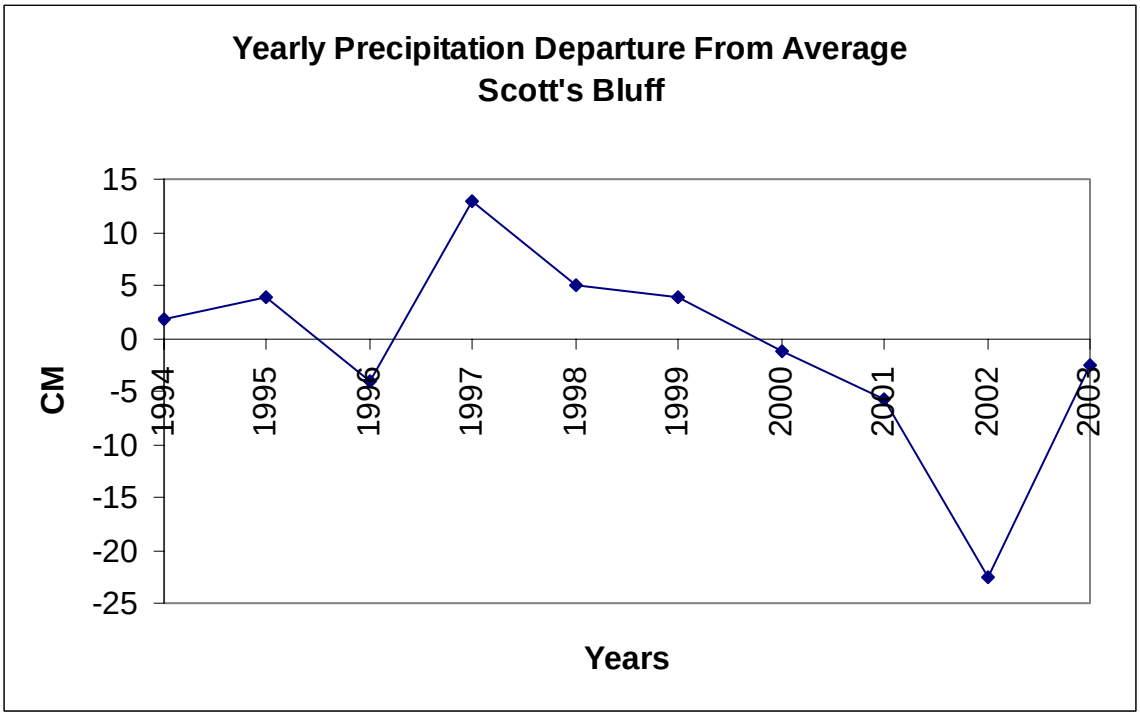

Figure 7: Departure from average precipitation at Scott's Bluff National Monument, 1994 – 2003.

Park Unit	Size (hectares/acres)
Devil's Tower National Monument	550/1360
Fort Laramie National Historic Site	337/833
Fort Union Trading Post National Historic Site	182/450
Jewel Cave National Monument	548/1355
Knife River Indian Villages National Historic Site	711/1758
Mount Rushmore National Memorial	501/1238
Scott's Bluff National Monument	1215/3003

Table 1: Size of the park units inventoried in this study.

Habitat Type	Survey Type	Survey Hours
Ponderosa Pine	VES	30
Grassland	VES	16
Prairie Dog	VES	2
Riparian/Cottonwood	VES	16
Ponderosa Pine	CALLING	20*
Grassland	CALLING	4*
Prairie Dog	CALLING	0*
Riparian/Cottonwood	CALLING	9*

Table 2: Effort expended on surveys of various types at Devil's Tower National Monument. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed. We also conducted two trail surveys and six salamander surveys at night.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	Y	Y
Bufo cognatus	Y	N	Y
Bufo woodhousii	Y	Y	Y
Pseudacris maculata	Y	Y	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	Y	Y
Apalone spinifera	Y	N	P
Chrysemys picta	Y	N	Y
Chelydra serpentina	Y	N	Y
Phrynosoma hernandesi	Y	N	Y
Sceloporus graciosus	N	N	N
Coluber constrictor	Y	Y	Y
Crotalus viridis	Y	N	Y
Heterodon nasicus	Y	N	Y
Lampropeltis triangulum	Y	Y	Y
Pituophis catenifer	Y	Y	Y
Thamnophis elegans	?	N	N
Thamnophis radix	?	N	Y
Thamnophis sirtalis	Y	Y	Y

Table 3: Species expected on Devil's Tower National Monument by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Devil's Tower. Y = expected; N = Not observed; P = possibly present.

Habitat Type	Survey Type	Survey Hours
Grassland	VES	22
Riparian	VES	20
Riverine	VES	20
Grassland	CALLING	16*
Riparian	CALLING	37*
Riverine	CALLING	11*

Table 4: Effort expended on surveys of various types at Fort Laramie National Historic Site. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	N	Y
Bufo cognatus	?	N	P
Bufo woodhousii	Y	Y	Y
Pseudacris maculata	Y	Y	Y
Rana catesbeiana	?	N	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	N	Y
Apalone spinifera	?	N	P
Chrysemys picta	Y	Y	Y
Chelydra serpentina	Y	Y	Y
Cnemidophorus sexlineatus	N	N	N
Holbrookia maculata	?	N	N
Phrynosoma hernandesi	Y	N	Y
Sceloporus graciosus	?	N	N
Sceloporus undulata	?	N	N
Coluber constrictor	Y	Y	Y
Crotalus viridis	Y	Y	Y
Heterodon nasicus	Y	N	Y
Lampropeltis triangulum	Y	N	Y
Pituophis catenifer	Y	Y	Y
Thamnophis radix	?	N	P
Thamnophis sirtalis	Y	Y	Y

Table 5: Species expected on Fort Laramie National Historic Site by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Fort Laramie National Historic Site. Cope (1900) reported *Phrynosoma hernandesi* from Fort Laramie but we would like to see more recent records. Y = expected; N = Not observed; P = possibly present.

Habitat Type	Survey Type	Survey Hours
Grassland	VES	28
Riparian	VES	22
Riverine	VES	4
Grassland	CALLING	6*
Riparian	CALLING	15*
Riverine	CALLING	2*

Table 6: Effort expended on surveys of various types at Fort Union Trading Post National Historic Site. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed. We also conducted two road surveys and three trail surveys at night.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	N	Y
Bufo cognatus	?	N	Y
Bufo woodhousii	?	Y	Y
Pseudacris maculata	Y	Y	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	N	Y
Apalone spinifera	?	N	N
Chrysemys picta	Y	N	Y
Chelydra serpentina	Y	N	Y
Phrynosoma hernandesi	?	N	N
Sceloporus graciosus	?	N	N
Coluber constrictor	Y	N	Y
Heterodon nasicus	Y	N	N
Liochlorophis vernalis	?	N	P
Pituophis catenifer	Y	N	Y
Thamnophis radix	Y	Y	Y
Thamnophis sirtalis	Y	N	Y

Table 7: Species expected on Fort Union Trading Post National Historic Site by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Fort Union Trading Post National Historic Site. Y = expected; N = Not observed; P = possibly present.

Habitat Type	Survey Type	Survey Hours
Pon. Pine Burned	VES	4
Pon. Pine Unburned	VES	22
Lagoon	VES	4
Lagoon	CALLING	2*
Pon. Pine Burned	CALLING	3*
Pon. Pine Unburned	CALLING	1*
Springs	CALLING	3*

Table 8: Effort expended on surveys of various types at Jewel Cave National Monument. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	Y	Y
Bufo cognatus	N	N	N
Bufo woodhousii	Y	Y	Y
Pseudacris maculata	Y	Y	Y
Rana pipiens	Y	N	Y
Spea bombifrons	Y	N	N
Chrysemys picta	Y	N	N
Chelydra serpentina	Y	N	N
Phrynosoma hernandesi	?	N	Y
Sceloporus graciosus	N	N	P
Coluber constrictor	?	N	N
Crotalus viridis	N	N	P
Heterodon nasicus	N	N	N
Lampropeltis triangulum	Y	N	Y
Liochlorophis vernalis	?	N	N
Pituophis catenifer	Y	N	P
Storeria occipitomaculata	?	N	N
Thamnophis elegans	Y	Y	Y
Thamnophis sirtalis	Y	N	P

Table 9: Species expected at Jewel Cave National Monument by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Jewel Cave National Monument. Y = expected; N = Not observed; P = possibly present.

Habitat Type	Survey Type	Survey Hours
Riparian	VES	34
Grassland	VES	24
Riparian	CALLING	20*
Grassland	CALLING	10*

Table 10: Effort expended on surveys of various types at Knife River Indian Villages National Historic Site. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed. We also conducted four salamander surveys and six driving and trail surveys at night.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	N	Y
Bufo cognatus	Y	N	Y
Bufo woodhousii	Y	Y	Y
Pseudacris maculata	Y	Y	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	N	Y
Chrysemys picta	Y	N	Y
Chelydra serpentina	Y	N	Y
Coluber constrictor	Y	N	Y
Crotalus viridis	N	N	N
Heterodon nasicus	Y	N	P
Liochlorophis vernalis	N	N	P
Pituophis catenifer	Y	N	Y
Thamnophis radix	Y	Y	Y
Thamnophis sirtalis	Y	Y	Y

Table 11: Species expected to occur at Knife River Indian Villages National Historic Site by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Knife River Indian Villages National Historic Site.

Habitat Type	Survey Type	Survey Hours
Ponderosa Pine	VES	14
Ponderosa Pine	CALLING	5*

Table 12: Effort expended on surveys of various types at Mount Rushmore National Memorial. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	N	Y
Bufo woodhousii	Y	N	N
Pseudacris maculata	Y	Y	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	N	N
Chrysemys picta	Y	N	N
Chelydra serpentina	Y	N	N
Phrynosoma hernandesi	?	N	N
Coluber constrictor	?	N	N
Crotalus viridis	N	N	N
Lampropeltis triangulum	Y	N	Y
Liochlorophis vernalis	?	N	Y
Pituophis catenifer	Y	N	N
Storeria occipitomaculata	?	N	Y
Thamnophis elegans	Y	Y	Y
Thamnophis sirtalis	Y	Y	Y

Table 13: Species expected at Mount Rushmore National Memorial by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Mount Rushmore National Memorial.

Habitat Type	Survey Type	Survey Hours
Badlands	VES	26
Grassland	VES	22
Riparian	VES	18
Badlands	CALLING	4*
Grassland	CALLING	5*
Riparian	CALLING	34*

Table 14: Effort expended on surveys of various types at Scott's Bluff National Monument. *: Number of calling surveys are listed; time spent on each calling survey was 15 minutes, but call survey effort is more accurately portrayed as the number of surveys performed. We also conducted three salamander surveys and six trail and driving surveys at night.

Species	NPS Expected	SMB Observed	SMB Reevaluation
Ambystoma tigrinum	Y	Y	Y
Bufo cognatus	Y	N	Y
Bufo woodhousii	Y	Y	Y
Pseudacris maculata	Y	Y	Y
Rana catesbeiana	Y	Y	Y
Rana pipiens	Y	Y	Y
Spea bombifrons	Y	Y	Y
Apalone spinifera	Y	Y	Y
Chrysemys picta	Y	N	Y
Chelydra serpentina	Y	N	Y
Terrapene ornata	X	Y	Y
Aspidocelis sexlineatus	Y	N	P
Eumeces multivirgatus	Y	N	Y
Eumeces obsoletus	X	N	Y
Holbrookia maculata	Y	N	P
Phrynosoma hernandesi	Y	N	Y
Sceloporus graciosus	?	N	P
Sceloporus undulata	?	N	P
Coluber constrictor	Y	Y	Y
Crotalus viridis	Y	Y	Y
Heterodon nasicus	Y	N	Y
Lampropeltis triangulum	Y	N	Y
Pituophis catenifer	Y	Y	Y
Thamnophis radix	Y	N	Y
Thamnophis sirtalis	Y	Y	Y

Table 15: Species expected at Scott's Bluff National Monument by the National Park Service (NPS), those observed by the authors (SMB), and a reevaluation of the species list for Scott's Bluff National Monument. X (*Terrapene ornata* and *Eumeces obsoletus*) indicates that these species were not on the original NPS list.